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Using Technology Based Student Led Discussions to Promote Constructive Learning in Chinese Primary Schools

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Abstract

The many valuable aspects of Chinese education have been seen throughout the world. For example Chinese teachers have been invited into the UK to instruct UK teachers on how to improve the quality of Mathematics education there. However, from 2001 onwards the government of China has sought to import pedagogies from the West in order to tackle observed problems with their own education system. Many scholars feel the problems the government were trying to address – the lack of critical thinking, a tendency to rote learning and an exam focused mind-set – would lead to failure for these techniques. However, these studies have all been with older students in high school and beyond. Little or no work has focused on students in the primary grades. Casual observation of Chinese primary school students would imply that they have no trouble in coming up with ideas and discussing them. The initiative for the study in this thesis has therefore been to see if this age range of students would be open to discussion based classes. A study was undertaken to determine if the removal of the teacher from control of the discussion would facilitate this age group to partake in face to face discussion. Other aims were to see whether constructivist learning would result or would the face based, hierarchical Confucian background education system prevent this. The original study was encouraging and as a result a technology based intervention was developed to see if this could help to improve the discussion and would allow further opportunities for students to feel able to engage. To encourage this the new system was also made anonymous. A third study was introduced to see if this approach could prove beneficial to the teachers also as to get such approaches adopted in Chinese schools the teachers would also need to see the benefit of the approach.

The resultant study has demonstrated that not only do Chinese primary school students engage in face to face study but they also can be further encouraged by use of an online system. Further developments also indicate that the system can be valuable to the teachers who can use it as an aid to find out the preconceptions of their students and thus help them in developing a more focused curriculum. The thesis ends by describing ways in which this study can continue to have a positive impact in developing students' critical thinking skills.

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Chapter one Introduction

1.1 Rationale for the study

The prevailing impression of the Chinese educational system is that students in China learn by rote, and that much of the education in schools is about memorising and cramming for examinations. Chinese students are regarded as passive-obedient-learners (Sit, 2013). Confucian culture and examination-oriented education are regarded as two main reasons that have created this impression. Examinations play a key role in student success and are used as a means of quality control to indicate learning outcomes by Chinese governments across the region (Hill, 2010). For example, in China, the National Higher Entrance Examination (gaokao) is the key university entrance exam, and is taken by Chinese students at the end of grade 12. It is a very competitive exam and only top performing students are selected to enrol in prestigious universities. In order to gain the highest mark in the National Higher Entrance Examination (NHEE), Chinese students firstly need to enrol in a good secondary school which could increase the possibility for them to get higher grade. This can only be achieved if they first work hard from when they are in the primary school. The concept of the NHEE determining students' futures is widely accepted by Chinese teachers and parents, which makes them focus solely on ensuring their children pass the exam (Schmitz, 2011).

However, in 2001 Chinese educators noticed that this exam led education often comes at the cost of students losing their critical thinking and creativities. The Ministry of Education of the P.R.C (2001) claimed that it was their intention to reform the current pedagogy to help students develop communication and cooperation skills as well as critical thinking and creative problem solving skills. The Government tried to import western countries pedagogy to help with this reform. However, the difference in cultures and schooling between Chinese and western countries was seen as the main concern for Chinese teachers and educators who, therefore, limited the application of the new pedagogy in China (Gu & Schweisfurth, 2006; Sang et al., 2011).

Existing research has focused on how to help Chinese students improve their argumentation skills in higher education, but there is limited research which focuses on

how to help Chinese students to become active learners in primary school. Based on personal experience, students from primary schools are always keen to ask questions. However, there is limited opportunity for them to ask questions and discuss their thoughts and findings with other students. The main task for them is to finish a seemingly limitless amount of tests instead, and memorise the course information that is delivered to them by the teachers. The fact that Chinese students are regarded as passive-obedient-learners has been the conclusion borne out of the existing research about students in secondary and higher education. It was personal experience and interest that inspired the current investigation of whether Chinese students were passive-obedient-learners or not and how to design the new approach for Chinese students, especially for younger aged students, to provide an opportunity for them to become active learners.

1.2 Challenges for this study

A similar concern to that which The Ministry of Education of P.R.C (2001) found has been expressed by policy makers around the world (Jacoby, 2007). For example, the Thinking Together Project (Dawes, Mercer and Wegerif, 2000) and Dialogic Teaching (Alexander, 2004) have already been applied in British primary school classroom communication. In these types of classroom communications students are encouraged to reason and argue about ideas with others and are invited to adopt the habits of critical inquiry and challenge their previous experience. This new communication pattern applied in the classroom has been an inspiration to investigate how it can be applied in the Chinese classroom to provide opportunities for Chinese students to become active and critical thinking learners.

This classroom communication pattern, described as exploratory talk, was designed based on the socio-cultural theory. Students can socially interact with teachers and classmates to develop their communication skills and build knowledge through collaborative discussion. However, applying exploratory talk as an imported pedagogy for primary school students directly would lead to challenges created by the different Chinese educational environment. The main method of how exploratory talk is applied is that the teacher leads the discussion to formulate debate amongst the students. However, Chinese teachers have absolute authority in their relationship with students.

Chinese students would accept information delivered from their teacher without questioning (Liu, 1986). Based on this situation, student-led discussion would be more beneficial in promoting communication and understanding when individuals contribute to interactions with more or less equal capabilities to others. Student led discussion implies that all students can be engaged in the reciprocal process of actively exploring and sharing each other's reasoning and viewpoints.

In the study for this thesis student-led discussion is applied as a new approach to help provide opportunities for Chinese students to actively explore and share each other's reasoning and viewpoints. There are three main challenges faced which the gap in current research has not covered.

RQ 1: Do Chinese students aged 8-11 still engage in student-led discussion based on their Confucian hierarchy-based background?

Objective:

- *To identify the challenges of Confucian hierarchy-based cultural background limited students' engagement in peer-to-peer discussion*
- *To determine whether a Confucian hierarchy-based background is a factor that prevents younger Chinese students from joining discussions*

RQ 2: How does cognitive conflict play a role in student-led discussion and lead Chinese students to challenge the inconsistency they confront and thereby enable them to become involved in the knowledge construction process?

This question can be further divided in two sub questions, as follows:

RQ 2.1: What types of reactions occur in a Chinese, student-led, face-to-face discussion?

RQ2.2: Which of these possible types of responses are statistically significantly and reveal significant patterns in the student-led learning environment?

Objective:

- *To identify the challenges of incorrect information generated from peer-to-peer discussion misleading students' understanding*
- *To observe and analyze how Chinese students behave in a face-to-face peer-to-*

peer discussion

- *To investigate how cognitive conflict plays a role in this discussion*

RQ 3: How can technology-based intervention help to provide a stimulus and become accepted by Chinese teachers?

This question can be further divided in three sub questions, as follows:

RQ3.1: How does the pattern of interaction differ between face-to-face discussions and online student-led discussions for Chinese students?

RQ3.2: How could induced cognitive conflict affect peer interaction and knowledge construction when technology-based intervention is applied?

RQ3.3: Can student-led discussion as supportive tool be accepted by Chinese teachers within the Chinese education system?

Objective:

- *To investigate how technology can support discussion to achieve better interaction and overcome the limitations of face-to-face based discussion*
- *To observe and analyze how students behave in a technology supported discussion and how technology supported discussions affect the role of cognitive conflict in the discussion*
- *To identify challenges of Chinese teachers' conceptions of integrating technology into education and the limited application of a technology supported peer to peer discussion tool*
- *To explore how a peer-to-peer discussion supportive tool can be accepted by teachers and applied to students' learning*

To answer these questions, the research was divided into a research literature review, a preliminary investigation (the initial observations of how Chinese students behave in a face-to-face based peer-to-peer discussion in the classroom), and two further investigations to observe how Chinese students behave in technology supported peer-to-peer discussion and how this technology-supported discussion can be accepted by Chinese teachers. The structure of the thesis is discussed in the next section.

1.3 Structure of the thesis

There are eight other chapters in this thesis. Chapter two is a literature review and is divided into three parts. The first part presents the background context information about Chinese education. It introduces the overview of the education situation in China, and then illustrates how the Chinese education situation impacts Chinese students. It then addresses the problems based on teaching strategies currently applied in the Chinese classroom and highlights limitations for applying new imported pedagogy in Chinese education. The second part, critically discusses the theoretical underpinning of the research. In the third part, it mainly focused on reviewing how the role of technology can play to stimulate students' learning and overcome the challenges that students and teachers will face when this new approach is applied in the Chinese education system.

Chapter Three presents the methodological framework of the research. It starts by presenting the research design which is led by the research questions and results of each study, and then introduces the research partners involved in this study. Ethical issues are also discussed. It moves on to discuss research methods and explains why mixed research methods are appropriate in this study. Finally, it illustrates the mixed approaches of data analysis techniques applied to evaluate data and also to explain why the different data analysis techniques used are appropriate in this study.

Chapter Four presents the findings of whether Chinese students would engage in the student-led discussion in the face-to-face based classroom and what kinds of reactions they perform during the discussion. The discussion is also provided in this chapter in relation to the findings.

Chapter Five presents how technology based discussions can be designed as an intervention to support Chinese students' discussions to overcome the limitations introduced in Chapter Four. It explains the main functions and characteristics of the system to support the Chinese students' learning.

Chapter Six presents the findings of how Chinese students' interactive pattern is performed differently between face-to-face student-led discussions and online student-

led discussions. It also illustrates how the role of cognitive conflict affects students' behaviour relative to knowledge construction.

Chapter Seven examines how technology supported student-led discussion is evaluated by students and teachers and their perspectives. Findings of evaluation from students highlighted the advantage of how this technology supported student-led discussion benefit students' learning. Additional, the findings of evaluation from teachers implied how extended functions could be designed to support teachers' teaching.

Chapter Eight explores how the application of this technology based intervention might not only help to provide an opportunity for Chinese students' learning, but also can become accepted by Chinese teachers.

Chapter Night is the discussion and conclusion. It starts by presenting answers to the research questions proposed in Chapter One. It then explains the implications of the findings in this study. Finally, it concludes the thesis with a review of the limitations of this study and implications for further research.

1.4 Expected contributions

Exploring how to design the new approach supported by technology for Chinese students, especially for younger aged students, to provide an opportunity for them to become active learners will be immense value in Chinese education. It is expected that this work will make contribution on implication of teaching and learning strategy for Chinese primary school students and teachers. Additional, it is also expected that this work will contribute on how technology can be designed to not only aid Chinese students' question asking and answers sharing but also be accepted by Chinese teachers to integrate into existing Chinese education system. Ultimately, it is expected that Chinese students have more opportunity to ask and share to improve their thinking and communication skills rather than passively received knowledge delivered from teachers, which can complement to the existing Chinese education system, and will additionally benefit other areas.

2 Chapter Two Background and literature review

2.1 Introduction

The problem proposed in Chapter One is that Chinese students learn by rote and are, as a consequence, regarded as passive-obedient-learners. Many of the newly imported pedagogies to help to develop Chinese students' communication and thinking skills are applied in only limited numbers in the Chinese classroom. In order to explore how technology can play a role in providing an opportunity for Chinese students aged between 8-11 to become involved a new learning approach to become active-critical-learners, which is in contrast with their existing traditional learning approach, it would be necessary to make a review of the current Chinese education system.

In this chapter, the first part (Section 2.2) reviews the background information regarding the Chinese education system and will illustrate the reasons that effect Chinese students into becoming passive-obedient-learners. Firstly, an overview of the education situation in China from its historical origins through to the current situation (Section 2.2.1) will be discussed. The following Section (2.2.2) will explore how Chinese students' behaviour is affected by factors of the Confucian culture and teaching strategy. Finally, the reasons for the limitations of an imported pedagogy in China will also be discussed (Section 2.2.3)

After reviewing the background information of the Chinese education system and how this system would effect Chinese students, the second part of this Chapter (Section 2.3) is a review of the current literature about how peer interaction can be designed as the new approach for Chinese students to provide an opportunity for them to become active-critical-learners. Firstly, a range of theoretical perspectives and empirical findings are described to clarify why peer interaction can be a good approach when applied to help Chinese students. Section 2.3.1 explains the theoretical perspectives of peer interaction based on Piaget and Vygotsky's theory. In the following section (2.3.2), three different factors that would affect peer interaction: experience, peer influence and peer

scaffolding are discussed, which also plays a key role in designing the new approach for Chinese students. However, the challenge is the child-child peer interaction that is a new approach which would cause conflicts between students. This challenge leads to a review from the literature of the role of cognitive conflict and how it can influence students' learning from literature (see Section 2.3.4). After reviewing the literature, it is proposed that cognitive conflict can contribute towards students' reflection and encourage them to take action to achieve conceptual changes. Section 2.3.4.3 explores the effectiveness of cognitive conflict as the strategy in science education. The limitation of cognitive conflict as a strategy in existing literature will also be discussed (Section 2.3.4.4).

In the third part of this Chapter (Section 2.4), mainly focuses on reviewing how the role of technology can play to stimulate students' learning and overcome the challenges that students and teachers will face when this new approach is applied in the Chinese education system. Firstly, it will discuss how technology could support students' collaborative learning compared with face-to-face learning environment (Section 2.4.1). Secondly, existing technologies that researchers applied in empirical studies to support students' active learning will be summarized, which would help to shed light on how technology can be designed to fit Chinese students (Section 2.4.2). Thirdly, the issues of E-safety and Chinese teachers' perception of integrating technology into education as two main concerns when designing technology for Chinese students will be also addressed (Section 2.4.3). Finally, Section 2.4.4 explains the existing literature regarding the methodology applied in this evaluation of computer supported collaborative learning. After clarifying the overarching research aims through the literature review, sub research challenges are proposed in Section 2.5 with explanations of how they are explored in the following chapters.

2.2 Background Information

2.2.1 Overview of the education situation in China

2.2.1.1 The history of education in China

The historical origins of Chinese education can be traced back to the 16th century B.C. during the late Xia Dynasty (1523 – 1027 B.C). The Chinese imperial examination (ke-

ju 科举) originated in the Han Dynasty (206 B.C – A.D 220) but was first implemented in the Tang Dynasty (618 – 896 A.D). The imperial examination continued to be used and changed little over the centuries until the Qing Dynasty (1644 – 1912). The compulsory texts for students to prepare for the exam were The Four Books and Five Classics (四 书 五 经 Sì-shū Wǔ-jīng), which are the authoritative books of Confucianism in China. Confucianism played a significant role and affected the Chinese education system (Li & Wegerif, 2014). One feature delivered by Confucianism is to advocate an enquiry based learning strategy by teaching students how to learn freely from anyone. In addition, the Analects also encourage students to learn and accept knowledge with a questioning mind-set. Another feature that the Confucian philosophy highlights is that silence does not equal inactivity but is seen as a way of self-reflection (Li & Wegerif, 2014). Later, in order to pursue social stability and harmony for the whole of society in the Confucian era, a hierarchy is realised, the Confucian culture has delivered controversial thoughts which affect Chinese education. For example, the role of the teacher was that they were regarded as the model of wisdom and morality. Students should treat them with full deference, respect and gratefulness. According to the Confucian ideology of harmony and a hierarchical society, the teacher gradually becomes the focus of authority playing a dominant role in education with total respect from obedient students (Chan, 1999).

At the beginning of the 20th Century many Chinese intellectuals advocated reform of the existing Chinese education system in order to revitalise China itself when China was confronted by the most acute challenges from the west, which led to the traditional imperial examination being abolished in 1905 (Chan, 2006). From then on the curriculum was significantly influenced by western civilization. The Confucian classics were no longer the only source of standard and valid education, and much modern natural and social scientific teaching was introduced and brought into China (Kuo, 1913). During the first decade of the 20th Century there was an increasing number of Chinese students who left to study aboard in countries such as Japan, Europe and the United States to receive a higher level of education before returning home to China. Additionally, equal opportunities in education were offered for both sexes by the modern education system in 1908, which was the beginning of formal education for women in China (Djung, 1934). Furthermore, the private informal education institution

(*Sishu*) was gradually replaced by formal schools (Gao, n.d.). However, this did not mean that the old style school (*Sishu*) simply disappeared; in contrast the coexistence of old style schools (*Sishu*) and formal schools were still to be found right into the 1950s.

In 1949, the Chinese education system changed significantly again due to the Communist party coming to power (Cui & Zhu, 2014). Education was mostly provided by public authorities such as the government and operated in a highly centralized way. Although the development of education was seriously affected by the Great Cultural Revolution in 1966, the education system was rebuilt after 1976 and the national college entrance exam was introduced in 1977. Also, the nine years compulsory education was introduced to popularize learning in order to create an educated citizenry in 1986 (Chan, 2006).

Throughout the history of education in China examinations have played a very important role. In the traditional education system the imperial examination was adopted as a path for social upward mobility. In the current modern education system the national college entrance exam has been regarded as the path to enroll in a good university and achieve a good career. Chan (2006) used the term of pragmatism as one of the characteristics of education in China. Most people have been told that "knowledge can change one's destiny", which resulted in them treating education and studying as "instrumental" to strive for wealth rather than for knowledge's sake. Therefore, an examination-centred purpose in education is the prominent influence within school policy and the education system, as well as teaching/learning styles and classroom arrangements (Chan, 1999; Zhu, C., Valcke, M., & Schellens, 2010). Examination centric education creates schools that are exam-oriented rather than student oriented, which indicates that schools pay more attention to exam results rather than individual demands (Chan, 1999; Sit, 2013). With the highly competitive nature of other schools, it can be assumed that schools spend more effort in improving school discipline for better examination achievements rather than a creative environment for individual development (Cheng, 2010; Mok et al., 2008). In the classroom situation, Chinese students receive heavy and tense subject arrangements and content (Cheng, 2010), which is far more advanced than how western students learn. The teaching strategy is also designed by teachers to help students obtain higher grades in an

examination oriented education (Cheng, 2010), under the pressure of university enrolment rates required by the school and parents.

2.2.1.2 The diversity of education in China

Although Chinese education operated in a highly centralized way after 1949, the government started to promote decentralization in the administration and financing of basic education in 1985 (Chan, 2006; Cui & Zhu, 2014). This decentralization led immediately to diversity of education in China because of the differences in local economies (Lee et al., 2016). Two examples were applied to illustrate how decentralization led towards the diversity of education and affected Chinese education. Shanghai is one of China's most developed urban areas in the eastern coastal regions of China, which also was the first city to achieve universal primary and secondary education (Cui & Zhu, 2014; OECD, 2010). Shanghai was offered a privilege to reform education such as curriculum reform and examination reform. For example, since 1988, Shanghai focused more on quality-oriented education compared with examination-orientated school practices (Ding, 2010). Since 1998, Shanghai has aimed to transform students from passive receivers of knowledge to active learners (Cui & Zhu, 2014). Additionally, based on these two waves of reform, Shanghai achieved a good performance in the PISA 2009 (OECD, 2010). However, on the contrary, people in western rural cities of China had far less access to education, including basic education (Lee et al., 2016). Three main problems highlighted in western China rural education were poor school hardware conditions, shortage of government funds for education and a shortage of teachers (Lee et al., 2016; McQuaide, 2009). The policy of decentralization is that there is not enough economic development to support local education. Hannum and Park (2002) highlighted that Shanghai spent about five times more than the poorest rural areas on primary education in the early 1990s, and one decade later Shanghai spent ten times more than the poorest rural area. Zhuang and Lai's (2002) finding also showed that 44.4% primary school teachers had a college diploma or university degree in the urban centers in eastern China, by contrast, only 15.6% of primary teachers in rural areas had an equivalent degree.

This overview helped to understand the history and diversity of education in China. In the following section, further explanation as to how the current Chinese education

system directly affects students will be provided.

2.2.2 The impact of Chinese education on students

Based on the overview of the education situation in China in Section 2.2.1, this section will evaluate two main reasons why Chinese students are commonly defined as passive quiet students and lacking in critical and creative thinking (Chiu, 2009; Nield, 2004; Shi, 2006; Sit, 2013) from the Chinese education background.

Firstly, the Confucian culture was one of the reasons widely discussed as having an effect on students' behaviour. Confucian culture gradually led to the authority of the teacher, which makes the relationship between teacher/pupil strongly hierarchical (Chan, 1999; Salili, 2001; Watkins & Biggs, 1996). This hierarchical line leads students to regard teachers as all knowing, and to accept the education, which is transmitted by teachers without question or discussion. With this form of teaching and learning; students are quiet and obedient, which supports the Chinese teaching philosophy that demands students respect and obey their teachers (Liu, 1986). Chinese students also try not to voice different opinions to those of their teachers and peers in order to avoid being criticised or laughed at by them (Cheong & Cheung, 2008). This is why a large body of literature points out that many Chinese students would remain silent by keeping their thoughts to themselves and would not stand up to answer teachers' questions. For example, Wang (2011) conducted a survey on 100 Chinese primary school students from 4^{th} – 6^{th} grade to examine how Chinese students behave during classroom interaction. The result showed that 46% students are afraid to show their answers because they are afraid of being criticized by teachers or laughed by teachers. Berland & Lee (2012) also used term of "saving face" to explain that Chinese students reluctantly express their own thoughts as they are afraid of giving the wrong answers. In the students' perspective, they will avoid speaking up in front of the class to avoid the risk of losing face for not meeting the expectations from teachers or peers which would generate a sense of shame (Chan, 1999).

Secondly, teaching strategy is another reason that impacts upon students. As discussed in Section 2.2.1, the examination-centred purpose in education effects the school policy and teaching and learning styles, which leads to the main teaching style that teachers

adopt in the Chinese classroom from primary school to university as one of feeding knowledge to students which is similar to the teaching style of the lecture (Zhu, Valcke & Schellens, 2010). Chinese teachers stand in front of the students and deliver the information required from the national curriculum. There is less opportunity for Chinese students to interact between learners and the instructor or between peers in class. According to Wang's (2011) study, 67% Chinese primary school students from year 4 to year 6 pointed out that there are less activities organized for them to show their ideas and interact with others in class. Chinese students are normally asked to provide answers to the questions, which are the closed question posted by the teacher. The main purpose of the teacher asking specific questions is to test whether their students understand the topic they are being taught (Fisher, 2013). Alexander (2006) described this interaction between teacher and students as "overwhelmingly monologic" in form, which means that the teacher only offers students opportunities for making brief responses to their questions and the teacher wants the students to provide the "right answer", rather than hold a discussion. This kind of teaching style leads students to focus only on how to find the correct answer for the question from their memory, and allowing little room for students asking questions or holding meaningful discussions (Topping & Trickey, 2014). With fewer opportunities for students' discussion in this teaching strategy, Chan (1999) also highlighted that Chinese teachers promote memorization as a good approach by asking Chinese students to remember the main points they listed for the examination which helps students to achieve a better score in the final examination. However, this approach makes Chinese students uncritically accept and memorise the "standard textbook" content without thinking deeply about the topic and understanding it in its entirety (Zhou, Knoke, & Sakamoto, 2005).

The majority of research highlighted that Chinese students behave silently and passively has been based upon students in higher education (Nield, 2004; Shi, 2006; Zhao & McDougall, 2008). Some literature pointed out that younger Chinese students show more of a preference to standing up to give their answers in the class discussion compared with older students (He, 2003; Liang, 2014). For example, He (2003) conducted survey on 3737 Chinese students aged from 10-18 years old and from 10 different provinces to prove the relationship between students actively presenting their answers in class with their age. Her study's results showed that of the students willing to stand up and present their ideas to the classroom, 13.8% were from primary school,

with 5.7% from middle and only 2.9% from high school.

Although these two reasons are mainly discussed in existing literature to explain why Chinese students would behave as passive-obedient-learners, the Confucian culture is still being adopted as the main reason to explain the learning style of students by most researchers (Chan, 2008; Chiu, 2009; Shi, 2006) compared to considering the reason being due to teaching strategy. Cheng (2000) argued that there is a distortion of Confucian doctrine used for explaining Asian students' reticence. In fact, some of Confucius' well known documents supports students' questioning and challenging the teachers (Cheng, 2000). For example, as discussed in Section 2.2.1, Confucian philosophy advocates a learning strategy based upon enquiry and encourages students to learn and accept knowledge with a questioning attitude. Many researchers suggest that specific educational context should be taken into consideration when observing students' silence/reticence to see whether this occurs beyond 'cultural differences', such as teaching styles/methodologies, classroom interactions and power dynamics in the classroom (Cheng, 2000; Liu & Littlewood, 1997; Wong, 2004). However, Zhao & McDougall (2008) pointed out that Chinese students prefer such passive teaching methods, rather than a participative teaching method. Some researchers argued that Chinese students, were found to have a strong desire to participate in classroom activities and showed a preference for a more student-led style of learning if given the opportunity(Cheng, 2000; Liu & Littlewood, 1997; Wong, 2004). For example, Liu (1997) conducted two large-scale surveys to examine why East Asian students' were reluctant to adopt active roles in classroom discussions. His survey results highlighted that Chinese students expressed that they do like communicative work in school and also that they preferred active discussion in the classroom, which was in sharp contrast to how the teacher perceived the students wished to act in class.. The survey also indicated that Chinese students mentioned that their most frequent classroom experience is "listening to the teacher". Liu's (1997) study also implied that Chinese students may prefer a more student-led style of learning, however, they do not have the opportunity to interact with other students and take an active role in class. This argument leads researchers to pay more attention to solutions for how a change in teaching strategy would affect Chinese students' learning. However, little attention is paid to how different teaching styles/methodologies, classroom interaction, knowledge sharing or exchange of students' classroom experience affects Chinese students' behaviour

especially for younger students.

This section discussed the Confucian culture and teaching strategy as two main reasons from the existing Chinese education system, which have an effect on Chinese students. Although the Confucian culture has been perceived as a reason for limiting Chinese students from actively joining in with classroom discussions and voicing different opinions to teachers and their peers (Watkins & Biggs, 1996), existing teaching strategy was another reason that limits the opportunity for students to show their ideas and interact with other students during their educational journey (Cheng, 2000). In the following section, an exploration of how new approaches applied from western countries could provide opportunities for Chinese students to engage in different teaching strategies is discussed. An explanation is also given as to the limitations of a new pedagogy being implemented from western countries when applied in Chinese classes.

2.2.3 Limitations of the new imported pedagogy in Chinese classes

Chinese educators noted as early as 15 years ago that the limitations (as discussed in the previous section) of the exam centric educational system comes at a cost to students' critical thinking and creativity. Many pedagogical programmes developed in the USA and Europe have been introduced into China to replace traditional Chinese pedagogy since the Ministry of Education of P.R.C. (2001) claimed that "helping students develop communication and cooperation skills as well as critical thinking and creative problem solving skills" was one objective of its curriculum reform. (Chan, 2011; Fung & Howe, 2012).

The *"Thinking Together Project"* (Dawes, Mercer, & Wegerif, 2004) and *"Dialogic Teaching"* (Alexander, 2006) are widely promoted within British primary schools' classroom communication. Alexander's (2006) approach is distinct with Mercer and his colleagues' approach. Mercer, Wegerif, and Dawes (1999) called *Thinking Together Project's* teaching strategy "exploratory talk". Exploratory talk regards dialogue as the prime tool to encourage students to arrange their own thoughts, hypothesising and justifying ideas collaboratively (Barnes, 2008), which is in contrast to formulating a

restricted, expected answer in the traditional Chinese classroom. In the exploratory talk model, the teacher not only delivers the important information to students, but can also provide an opportunity for students to share their own ideas and collaborative learning with the support of the teachers' guidance (Dawes, Mercer, & Wegerif, 2004). A software program called 'Talk Factory' which works together with an interactive whiteboard, has been developed to support exploratory talk in British primary school science plenaries (Kerawalla, Petrou, & Scanlon, 2013; Petrou, Kerawalla, & Scanlon, 2009). The further discussion of this Exploratory Talk approach will be discussed in Section 2.3.3.2.

However, there are limitations to be addressed in adopting imported pedagogical programmes into the Chinese classroom. Firstly, different cultures and schooling between Chinese and western countries would be the concern for most Chinese teachers and educators and puts the new pedagogy into question (Gu & Schweisfurth, 2006; Sang et al., 2011). For example, the new style of teaching methods would make Chinese teachers feel obliged to use unfamiliar practices in their classrooms. The size of the classroom in China is also a concern as an obstacle for the new pedagogy. There are, on average, 40-50 students in each class. Increasing the autonomy of each student in the class would result in fear of the teacher losing control of their class (Topping & Trickey, 2014). Additionally, the new pedagogy would challenge the school schedule which expects teachers to follow the curriculum closely and to accomplish the content within a limited class time (Cheng, 2010). For example, L. Hou (2009) tried implementing a new pedagogy by applying the WebQuest system to reform the traditional teaching for Chinese primary students. However, she concluded that she cannot give more independent thinking time for students to reflect because they have to accomplish content on time.

Secondly, a new pedagogy, which is not seen as congruent with the traditional Chinese culture, would encounter resistance from Chinese students (Li, Rao, & Tse, 2012; Nguyen, Terlouw, & Pilot, 2006). For example, the new pedagogy may require students to actively join in discussions to present their ideas in the teacher-led discussion. However, due to the Confucian heritage; students may prefer not to present their ideas or join the discussion to avoid conflict. However, in contrast to studies on how the culture would affect a new pedagogy for students, a comparative study conducted by

Dong et al., (2008) argues that there is a tendency to over-stress the factors of cultural determinism, when new ways of talking are applied to Chinese students. The results of their study show that Chinese students make a surprisingly fast adaptation to new patterns of speaking that require self-management, free participation and critical thinking. Dong et al.,'s (2008) study results also supported X. Cheng (2000) and Wong's (2004) viewpoints of the distortion of Confucian doctrine discussed in Section 2.2.2.

In summary, the teaching strategy applied in the existing Chinese classroom affects Chinese students' behaviour. The new pedagogy such as exploratory talk promoted from western countries would encourage students to present their own thoughts and discuss ideas collaboratively rather than passively formulating restricted answers to respond to teachers' questions in the class. This would seem to overcome the limitations that the current Chinese teaching strategy has to a certain degree. However, different cultures and resistance from Chinese students are still the two main reasons addressed to limit applying the new pedagogy from western countries. In order to explore how a new approach can be designed to provide Chinese students' with the opportunity to become involved in classroom discussions and to achieve research aims, the following sections will review the existing literature and empirical findings to come up with a new pedagogy as a new approach to support Chinese students' learning and explore how technology can play a role in it.

2.3 Literature review and theory review

In this section, mainly discusses how a new approach can be designed to support Chinese students' active learning. Different learning theories would be reviewed and discussed to evaluate a new approach for Chinese students in the second part of this chapter, which is summarized in Figure 2.1. Firstly, there is an evaluation of peer interaction as new approach from theoretical perspectives (see Section 2.3.1). Secondly, the three main factors which would affect peer interaction will be explained and this will also indicate the appropriate design of peer interaction for use with Chinese students (see Section 2.3.2). Thirdly, the challenges are highlighted when this kind of peer interaction leads to a misunderstanding spreading among students. However, the literature argues that cognitive conflict, which is generated when students are confronted with conflicting information, can also be applied as a teaching strategy

which can benefit students' learning (See section 2.3.4). Further research is reviewed to evaluate whether cognitive conflict can be an effective strategy for students' learning.

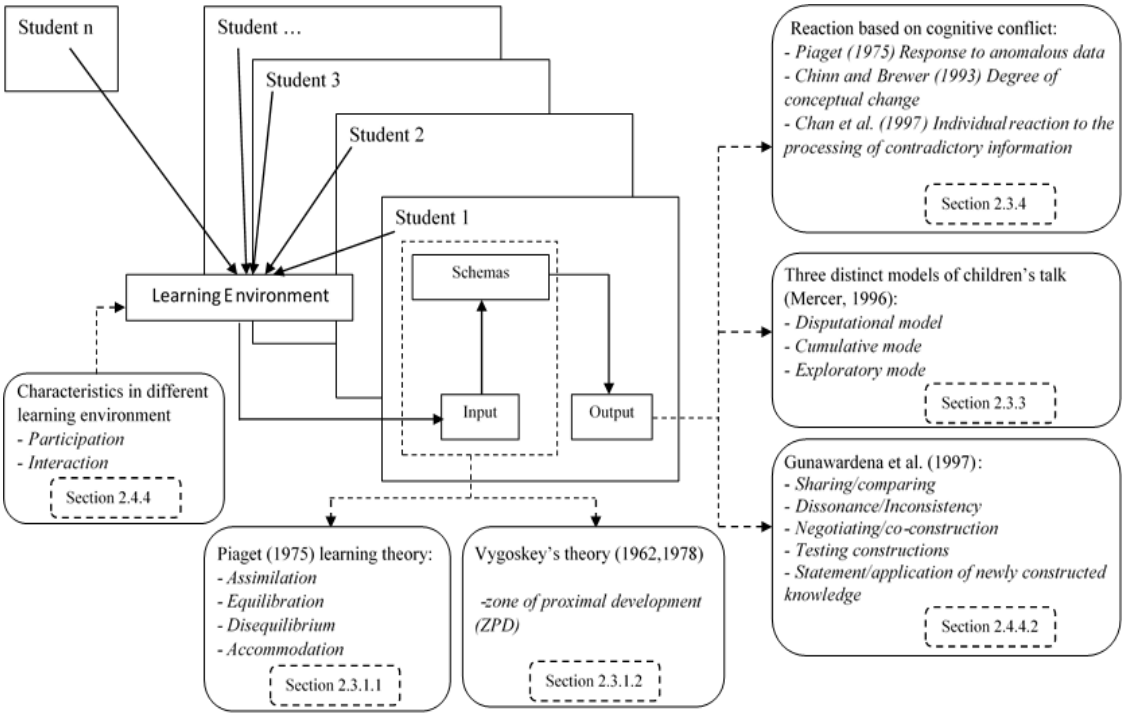


Figure 2.1 learning theories summarized to illustrate how new approach can applied for Chinese students

2.3.1 Theoretical view of peer interaction

Exploratory talk (ET) was regarded as a prominent type of classroom talk for peer interaction which has been applied in British primary schools successfully over the last 15 years (Mercer, Wegerif, & Dawes, 1999b). Yang (2016) also conducted this exploratory talk (ET) approach for Chinese students to improve their thinking skills. This peer interaction is based on sociocultural perspectives. In order to evaluate whether this sociocultural perspective based peer interaction could be applied to Chinese students, a review of the literature of how peer interaction could benefit students' learning based on a theoretical view is required. In the following sections, it is necessary to focus on the studies of Piaget (Piaget, 1955) and Vygotsky (Vygotsky, 1980). Their studies start from different perspectives to present peer interaction based on the individual cognitive and social cognitive viewpoint.

2.3.1.1 Piaget (1975): individual constructivism

Piaget's view of peer interaction mainly focuses on the individual's cognitive development (Fosnot & Perry, 1996). The term of conservativism was described by

Piaget (1975) to explain the active role of the individual in learning. O'Donnell and King (2014) pointed out that constructivism explained by Piaget (1954) in his theory had two relative meanings. Firstly, it refers to the refinement of existing cognitive systems over time. Secondly, it refers to the application of already formed cognitive systems that confer meaning in present circumstances. Piaget (1985) also shows how his model is used to explain how an individual's cognitive system would be affected during the refinement of existing cognitive systems and the application of already formed cognitive systems over time. His model is based on the hypothesis that children have their own mental model called schema. A schema was regarded as the cognitive framework that helps to store and interpret information in a variety of forms (Brown, A. L., & Cocking, 2000). Whatever children say and do is often based on an element, or a group of elements, from a schema. New experience or knowledge would reflect existing knowledge in their mental schema when children experience new things. If children can assimilate and accept new experiences or knowledge, it involves the absorption of new knowledge into an existing framework without changing anything (Hamer et al., 2011). Meanwhile, it also strengthens the schemas in their mental model (Swan, 2005). However, when children cannot use their existing schema to illustrate new information or knowledge which they are confronted by, a form of new information conflict occurs within their existing experience. Thus, children need to change their schema to fit and absorb this new information or knowledge (Piaget, 1985). This process can also be called disequilibrium to equilibration. In other words, this is the process of accommodating new information when children change their mental schema to fit a new experience. Based on this model, an individual can revise their current cognitive system (schema) to lead them to create new meanings (O'Donnell & King, 2014).

Piaget also maintained that peer interactions provide rich and necessary contexts for students to revise their current cognitive systems (O'Donnell & King, 2014; Piaget, 1985). Reflecting on peer reactions and perspectives serves as a basis for a student to revise his or her cognitive system. Such revisions would, in turn, lead students to make new meanings (O'Donnell & King, 2014).

2.3.1.2 Vygotsky (1962, 1978): social constructivism

In Vygotsky's theory (1978), he focuses on the social cognitive rather than individual cognitive processes. Compared to Piaget's theory, Vygotsky's theory emphasises the

interdependence of social and individual processes in the co-construction of knowledge (John-Steiner & Mahn, 1996). His theory views human development as a sociogenetic process by which children gain mastery over cultural tools and learn knowledge by interacting with others in their environment (O'Donnell & King, 2014). The role of language is highlighted in his theory (Vygotsky, 1980) as both a cultural tool (for the development and sharing of knowledge amongst members of a community or society) and as a psychological tool (for structuring the processes and content of individual thought). When children use language to interact with others it involves both an interpersonal (social, interactional) and intrapersonal (individual cognitive capabilities) process (O'Donnell & King, 2014). Based on Vygotsky's theory, most researchers defined characteristics of interaction as reciprocity, mutuality and the continual renegotiation of meaning (Barron, 2000; Howe & Mercer, 2007). In contrast to Piaget's study, Vygotsky focused more on the adult-child interaction (Vygotsky, 1980). He developed the concept of Zone of Proximal Development (ZPD) which is defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers". It supported the idea that children could achieve more and learn better with more knowledgeable peers. Vygotsky (1980) stated that it is very important for children to learn through social interaction with a skilful tutor. This skilful tutor could be a parent, teacher or peer. He used the term More Knowledgeable Other (MKO) to refer to someone who has a better understanding or a higher ability level than the learner. When learners get help from the MKO, they could learn and understand knowledge better (Levine & Munsch, 2010). Thus, in Vygotsky's view, the importance for peer interaction with more competent partners is stressed.

2.3.2 Factors influencing peer interaction

As can be seen from the discussion above on the theoretical view of peer interaction (Section 2.3.1), there are many different factors that would influence peer interaction when it is applied as the new approach for Chinese students. In the following sections, an explanation of how different prior experience that students have would affect peer interaction (Section 2.3.2.1). Secondly, peer scaffolding will be discussed based on the different types of peer interaction (Section 2.3.2.2). Finally, an explanation of how different relationships between peers would affect peer interaction such as child-child

interaction and adult-child interaction (Section 2.3.2.3).

2.3.2.1 Experience

“All learning involves transfer from previous experience”. Brown, A. L., & Cocking (2000) pointed out that the principle of learning is to use the previous knowledge that people have, to structure new understandings. Based on the Kolb's (1984) experiential learning theory, he regarded experience as a central role played in the learning process whereby knowledge is constructed from the continuously modified by experience. As theoretical perspectives of peer interaction based on Piaget and Vygotsky’s theory discussed, many researchers explained how the role of experience would effect students’ existing experience based on individual cognitive perspectives and social cognitive perspectives (Ellis & Goodyear, 2013; Strijbos, 2011). In Piaget’ theory, he stressed that the new experiences a child encountered would connect to a child’s existing experience. For example, during the peer interaction, student 1 will confront the different ideas from other peers regarded as input resources, which may affect student 1’s existing experience (E1). Student 1 would involve in the process of individual cognitive modification such as assimilation or accommodation, which is regarded as the black box as illustrated in Figure 2.2. There are three different possibilities for an individual to process the new experience from others when they are confronted with it (Limón, 2001; Mason, 2001). Firstly, the individual assimilates the new experience (E1’) into their existing schema. Secondly, the individual refuses to accept the new experience which conflicts with their current schema. Thirdly, the individual accommodates the new experience (E1’) and changes their existing schema.

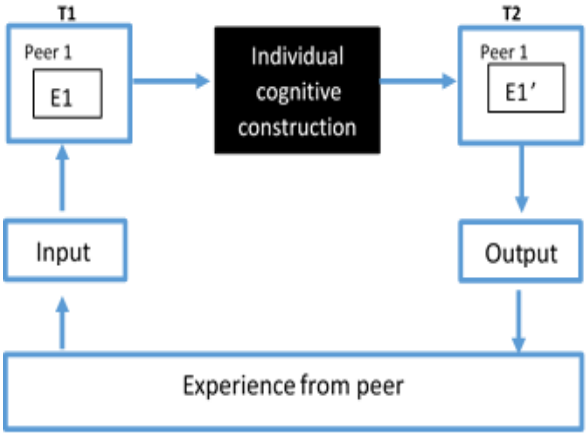


Figure 2.2 An example illustrated the role of experience plays in individual cognitive construction

In contrast to individual cognitive perspective, Ellis and Goodyear's (2013) perspective of the central role of experience is grounded in a relational perspective of "learning". They argued that learning is shaped through relations between the psychological (individual mind) and social (socio-cultural practices). Strijbos (2011) used the term of "distributed emergent experience" to describe how an individual exchanges their experience in collaborative learning (see Figure 2.3). He pointed out that interaction between students would affect their individual experiences but the distributed emergent experience received from others would be internalized differently due to their different previous experience. For example, as the Figure 2.3 illustrated, a peer interaction event starts at time 1 (T1) with each student (student 1 and student 2) based on their previous experience (E1 and E2). The event of peer interaction generates a "distributed emergent experience" (x). This distributed emergent experience will be internalized by each student at time 2 (T2). However, distributed emergent experience (x) is interpreted differently given their previous experiences (X' and X''). Social cognitive construction could be regarded as children sharing their different experiences as distributed emergent experiences in which the individuals involved compared their own experiences with those of another person. Conversation and interaction could help students to engage in the process of refinement and establishment of knowledge (Strijbos, 2011). Krueger & Zeiger (1993) supports that simply reaching a consensus on an agreed answer or by simply being confronted with a confliction on an answer that is not agreed with are totally different to the reciprocal processes of actively interacting with others to explore and share each other's reasoning and viewpoints. It is not simply collaborative interaction based purely upon agreement and cooperation, but may also include disagreement and conflict.

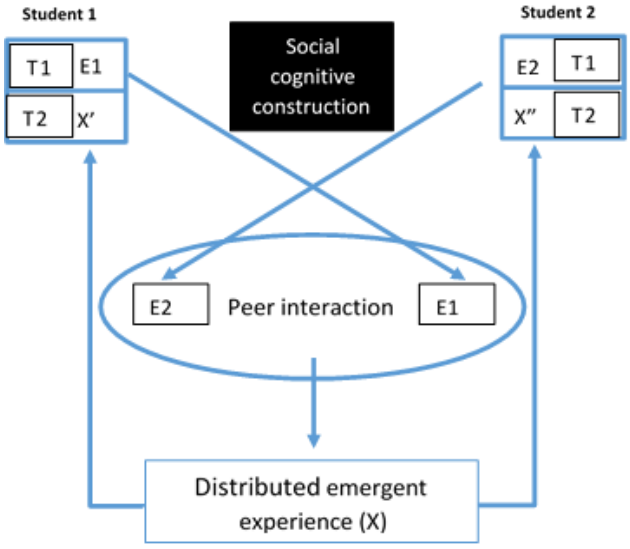


Figure 2.3 An example illustrated how the role of experience plays in social cognitive construction adapted from Strijbos (2011)

2.3.2.2 Peer scaffolding

There are three types of peer interaction within learning contexts which are distinguished as: peer tutoring, peer collaboration and cooperative learning (Damon, 1984; Damon & Phelps, 1989). In the view of Vygotsky's Zone of Proximal Development (ZPD) theory, the effective way for children to learn is to interact with more competent people. Vygotsky (1978) points out that children could achieve and learn better with support. Wood, Bruner and Ross (1979) used the term "scaffolding" to describe the support which is given during the learning process and is designed to help people achieve their learning goals. There is considerable debate about how peer scaffolding can provide support to children in order to achieve their goals (Fosnot & Perry, 1996). Some educators regard the scaffolding process as direct instruction, albeit at developmentally appropriate times (Ratner & Bruner, 1978); while others regard it as giving children new possibilities to consider (Graves, 1983). Bruner & Bruner (2009) argue that direct instruction or inappropriate scaffolding provided to children to reach their potential capability is not due to the children themselves. It is more likely that children borrow adult's consciousness to guide them through the zone of proximal development. During the peer scaffolding process there should be provision for more possibilities of problem solving solutions for children. It helps to encourage children to clarify each different possibility and come to conclusions by themselves (Fosnot & Perry, 1996). Many researchers (Brown et al., 1993; Goos, Galbraith, & Renshaw, 2002; Martin, 1993; Wertsch, 1984) found that the best scaffolding processes should be

involved in mutual adjustment and appropriation of ideas rather than by a simple transfer of information and skills from teacher to learner.

Peer interaction should mainly focus on peer collaboration. It helps students to interact with others with various possible ways of determining this information from others such as asking questions, agreement, disagreement and evaluation. It helps them to clarify different possibilities and come to a conclusion by themselves rather than simply receiving the information from an expert. Goos, Galbraith, and Renshaw (2002) distinguish between the traditional expert–novice interaction and interaction between individuals of equal status. The following section looks at how peer influence affects peer interaction when students are involved with different types of interpersonal relationships involved in peer interaction.

2.3.2.3 Peer influence

Interpersonal relationships play an important role in the socialization process (O'Donnell & King, 2014). The relationship of a unilateral authority is mainly focused on the adult—child relationship such as parent—child or teacher – child relationship (Damon & Phelps, 1989). This kind of relationship is regarded as being asymmetrical in nature. In this relationship children would respect the views of authority without a complete understanding of those ideas (O'Donnell & King, 2014). To a greater extent, young children may accept what they are told in a one-sided manner. However, based on the view of Vygotsky's theory, he focused on adult–child rather than peer interaction which is opposite to the Piagetian approach to cognitive development (O'Donnell & King, 2014). Vygotsky does not stress the social hierarchy when he proposes the theory of the zone of proximal development, but instead addresses the importance of interaction with more competent partners. It means that Vygotsky pays more attention to asymmetry in knowledge rather than in a social relation.

The relationship of cooperation is symmetrical when it is mainly focused on child – child relationships (such as equal capabilities or more capable children) (O'Donnell & King, 2014). In this relationship, it is more beneficial to have communication and understanding when individuals contribute to interactions with others of approximately equal capabilities to themselves (Harper & McCluskey, 2003). In contrast to unilateral

authority, it implies that all persons can be engaged in the reciprocal process of actively exploring and sharing each other's' reasoning and viewpoints (Harper & McCluskey, 2003; O'Donnell & King, 2014). In addition, each individual can also defend their own ideas or negotiate the meaning with others. Piaget (1975) agrees that social interaction between those of more or less equal capability would foster development, and that each individual then has more opportunity to engage in debate and discussion. It would lead to more sophisticated patterns of thought (O'Donnell & King, 2014). This idea is supported by several examples and are illustrated by the results from the experiments that were conducted, which supports that peer interaction during middle childhood shows more change in reasoning when children are paired with peers rather than adults (Harper & McCluskey, 2003; Kruger & Tomasello, 1986). However, there is still a large body of literature which points towards the greater benefits for children learning with adults (Chaiklin, 2013; O'Donnell & King, 2014).

2.3.3 Approach to the application of peer interaction in learning

2.3.3.1 Contributing Student Pedagogy (CSP)

Differing previous experience makes it difficult for a child to understand knowledge in a different way. Transferring and sharing helps the child to detect whether they understand a subject in the right way. Contributing Student Pedagogy (CSP) is promoted by researchers (Denny, P., Hamer, J., & Luxton-Reilly, 2008) and is based on the social constructivist theory. According to Vygotsky's *Zone of Proximal Development* (ZPD) theory (Chaiklin, 2003; Vygotsky, 1980) suggests that; if children have difficulty in understanding, they can share their questions and understanding with others. This collaboration then aids the child in identifying with other, more knowledgeable, persons. *Contributing Student Pedagogy* (CSP) helps to promote the child's understanding and to present their findings and understanding with others of a similar level. Children therefore, are encouraged to contribute their knowledge to others; meanwhile, children can also evaluate other children's contributions. There are two necessary components for this pedagogy (Denny, P., Hamer, J., & Luxton-Reilly, 2008). Firstly, children need to contribute and share understanding and knowledge. Secondly, children also need to evaluate each other's ideas and contributions. How to contribute and share an understanding and knowledge with other people is often a very difficult idea to transpose into words. *Artifact* is a concept whereby a child's contribution to

learning can be developed in various ways (Hamer et al., 2011). For example, the PeerWise project (Denny et al., 2008) asks children to design their own multiple choice questions (MCQ) to allow other children an opportunity to demonstrate the knowledge that they have by answering those questions. Other children can answer the questions and also evaluate whether the questions are correct. Based on the other children's answers, children can provide feedback and improve their question design. Hamer et al. (2010) showed that *Contributing Student Pedagogy* could help children to share and evaluate information with one another. Social interaction plays an important role in this pedagogy. During social interaction the most challenging part for the peers is when children confront conflicting information. It will motivate children to find evidence to persuade others or themselves. Piaget's theory (Piaget, 1954) argues that one has to change one's schema to fit the new information when it conflicts with one's prior experience. It is very challenging for children to persuade themselves, or others, when information conflicts with their previous experience. This learning process not only motivates children to consolidate their understanding of knowledge, but also helps other people to understand the problem. *Contributing Students Pedagogy* involves a peer-to-peer learning environment, which it is believed would be much more efficient than the traditional teaching pedagogy (Hamer et al., 2010). This is because children participate actively in learning and the learning environment and share their understanding and questions with other children. Conflict occurs when they confront discrepancies within the information, and this leads the child to find evidence to support their own ideas. This type of process involves the participant, reification and argument, and together they help the child to reflect on their previous experience to persuade other children (or themselves) to find a resolution.

2.3.3.2 Exploratory Talk

Another approach widely promoted in western countries is called exploratory talk which helps children develop their thinking skills and understand their knowledge (Mercer, Wegerif, & Dawes, 1999b). Exploratory talk regards dialogue as the primary tool to encourage students to arrange their own thoughts, hypothesising and justifying ideas collaboratively (Rajala, Hilppo, & Lipponen, 2012; Topping & Trickey, 2014). This is in contrast to formulating a restrictive, expected answer in the traditional classroom. Exploratory talk (ET) is regarded as the prominent type of classroom discussion in

primary schools based on peer interaction (Rajala, Hilpp, & Lipponen, 2012). Exploratory talk focuses on engaging critically but constructively with each other's ideas (Mercer, 1996). During the exploratory talk, statements and suggestions are offered for joint consideration. Challenges and alternative hypotheses are offered to justify an individual's viewpoints.

ET is distinguished from other types of peer talk, such as cumulative talk, in which speakers build positively but uncritically on what the others have said, and disputational talk, which is characterised by disagreements and individualised decision making (Chin & Osborne, 2010a; Kumpulainen & Mutanen, 1999; Osborne & Patterson, 2012). The fundamental theory is based on the sociocultural perspective. There are many benefits discussed in the literature on the impact on students' learning and discussion. Firstly, the peer interaction environment provides the opportunity for students to utilise thinking skills to enhance their learning (Alexander, 2010; DfE, 1999). Secondly, the students' learning motivation is stimulated and they can learn collaboratively. Students will verbalise their thinking to develop understanding which contributes towards developing communication skills (Alexander, 2010). Most literature (DfE, 2013; Yang, 2016) highlights that discussion is very important for students to explore ideas, explain answers, justify argumentation, evaluation and negotiating with others. White (2012) supported that opportunity for students to join a discussion not only develops students' language skills, but also how they use their language to construct thought and meaning to become successful thinkers, along with fostering a culture of curiosity and eagerness to learn. Thirdly, this kind of interaction can also improve self-confidence as the foundation for the 'community of enquiry' is established. Additionally, it can also help students learn to respect one another's opinions and challenge students' initial judgements through discussion (Yang, 2016).

This type of classroom discussion has begun to be adopted in western countries to promote students collaborative learning. One of the research projects from Dawes (2000) was designed to integrate teacher-led whole class dialogues and group activity. Within the programme, teachers worked with children to develop a shared conception of how they could talk and think together effectively (Mercer, Wegerif, & Dawes, 1999b). This research has produced three main findings. Firstly, children in intervention classes came to use much more exploratory talk than those in the control classes. Secondly, groups

who began to use more exploratory talk also became better at solving reasoning problems together. The third main finding was that children in the intervention classes made gains in their individual scores on tests of reasoning and of curriculum attainment (in mathematics and science) which were significantly greater than those made by the children in the control classes. The innovative software was also designed by Kerawalla et al., (2013) as the tool to model and represent students' (aged 9-11) engagement with the ground rules of exploratory talk in science education.

In summary, the approach of *Contributing Student Pedagogy (CSP)* mainly focuses on not only promoting students to present their findings and understanding with others, but also encouraging students to review other students' contributions. These are two necessary components for this pedagogy (Hamer et al., 2010). This pedagogy also highlights that conflict generated when students review other students' contributions, benefits other students enabling them to reflect on their previous experience in order to persuade other students (or themselves) to find a resolution after the process of participant, reification and argument. Similar to the approach of CSP, the approach of exploratory talk mainly focuses on how critical thinking and argumentation skills developed through negotiating with others during peer interaction. It is a dynamic process that builds a scaffold from teachers to explore ideas, explain answers, and justify argumentation and evaluation. The following section, will explain how these approaches can be applied for Chinese students when compared with the traditional Chinese teaching strategy. This will shed light on designing a new approach for Chinese students based on existing approaches.

Firstly, both approaches highlight that peer interaction provides the opportunity for students to exchange their different ideas based on their different experiences during discussions. This is different from the traditional learning strategy for Chinese students. In peer interaction, students expose their previous experience and are required to engage with another person's point of view which challenges their own conceptual understandings (Wolfe & Alexander, 2008). As discussed in Section 2.2.4, the main interaction in the classroom for Chinese students is with the teacher. They are expected to formulate a restricted, expected answer (Fisher, 2013) rather than freely exchange their own ideas based on their own experiences. In this situation, there is limited opportunity for Chinese students to present their own ideas which does not help them

in increasing their awareness gained through their previous experiences. As highlighted by Kolb (1984), experience plays a central role in the learning process whereby knowledge is constructed from and continuously modified by experience. Memorising and looking for the 'correct answer' to answer teachers' questions is not only unhelpful for knowledge construction, but also does not help the teacher to understand the students' previous experience and preconception of the specific topic.

Secondly, the characteristics of both approaches do not provide direct instruction to help students resolve problems. During peer interaction, students are encouraged to present their own different viewpoints to the question, which helps to provide many alternative answers for students' joint consideration. This could help in the development of problem solving skills rather more than simply delivering answers to students. In the traditional teaching strategy Chinese teachers prefer to deliver the main points for the exam to students and ask them to memorise the "standard textbook" content without thinking deeply and with understanding (Watkins & Biggs, 2001).

Thirdly, peer influence as a factor plays an important role when designing a new approach for Chinese students. In the strategy of exploratory talk, teachers are critical to the dialogue and guide their students to engage in reasoning during group work (Rajala, Hilppo, & Lipponen, 2012). With support from teachers during the discussion, the rules of talking (such as 'I disagree with X, because of y') are agreed and promoted by teachers to help students discover new and better ways of jointly making sense during the discussion (Dawes, Mercer, & Wegerif, 2004; Yang, 2016). The role of the teacher designed in the exploratory talk also helps to guide the dynamics rather than the content of the interaction (Alexander, 2006). Alexander (2008) highlights three conditions for teachers to focus on: "dialogic teaching is collective (teachers and children address learning tasks together), reciprocal (teachers and children listen to each other, share ideas and consider alternative viewpoints) and supportive (children articulate ideas freely without fear of embarrassment over "wrong" answers and help each other achieve common understandings)".

However, it is very difficult to apply it in the Chinese education background due to the authority of the teacher and the students' relationship with them which is strongly hierarchical (Chan, 1999; Salili, 2001; Watkins & Biggs, 2001). As discussed in the

peer influence section (section 2.3.2.2), if the Chinese classroom applies the strategy of exploratory talk directly, the role of the teacher would affect the interpersonal relationships during the peer interaction (teacher-student) discussion. Based on the Chinese classroom culture, Chinese students may accept what they are told in a one-sided manner without questioning and thinking (Liu, 1986). In contrast, the relationship of child-child could make all students engage in the reciprocal process of actively exploring and sharing each other's reasoning and viewpoints. Child-child interaction would be more suitable for Chinese students to provide social interaction between those of more or less equal capabilities, in which each individual has more opportunity to engage in debate and discussion without considering the authoritative role of teacher who could limit the ideas contributed by students.

Child-child interaction, promoted as the new approach for Chinese students, could provide equal opportunity for all students engaging in the reciprocal process of exploring and sharing ideas during interaction. However, there is another challenge that students would face in this student-discussion. Namely, incorrect knowledge and information shared by students to others which could mislead other students' understanding during child-child interaction discussion (Anderson, 2005; Minocha, 2009). The following section will provide an evaluation of the role of cognitive conflict which affects students' learning.

2.3.4 Cognitive conflict

Cognitive conflict is used to describe the situation where children experience discrepancy between their cognitive structure and the environment (Lee et al., 2003). As previously mentioned, the Contributing Student Pedagogy (CSP) allows children to share their contributions with each other and to review other's contributions. When children review each other's contribution, it triggers their cognitive conflict because they are confronting contradicting information. With supporting theory from Piaget (1985), disequilibrium can be used to illustrate a child's perturbation when they are confronted with confusion and when they try to understand new information. Piaget (1952) used the notion of perturbation to explain different situations that children will confront in peer interaction over time. He pointed out that there are two situations that children would experience during peer interaction. First are situations in which no

perturbation is experienced. There are possibilities that children would not experience perturbation during the peer interaction. Firstly, they agree with the information received from others. Secondly, they do not have relative prior experience about the received information which would not induce perturbation. In this situation, cognitive change is not present and the cognitive system would remain unchanged because no perturbation would be experienced. The second situation is one in which perturbations are experienced. Many researchers (Kang et al., 2005; Limón, 2001) have used another notion of cognitive conflict to describe the situation where children experienced perturbation. They explain that cognitive conflict can be induced by presenting a discrepancy in events that clearly contradicts the students' existing conceptions or previous experience.

However, Piaget acknowledges that the child may or may not reflect on their existing cognitive system and seek to take action. In addition, the process of reflection and action taken can be considered to be a search for logical coherence and conceptual change is only one of several possible options. The next section will discuss in more detail children's reflection and the action taken after cognitive conflicts are experienced.

2.3.4.1 Reflection

Reflection is defined as "a purposeful thinking toward a goal" (Dewey, 1933, P.118). It is considered as a mental route of one's internal problem-solving activity. Schon (2010) distinguishes two types of reflection; reflection-in-action and reflection-on-action, indicating that students reflect both during and after actions to improve learning. Reflection in action refers to the monitoring and modification of actions during the learning process. Reflection on action refers to the reasonable evaluation and strategic planning for improvement after the learning process. Self-correction promotes students' reflection when they consider their ideas with others (Yang, 2010). Peer review offers an opportunity to broaden and deepen students' thinking and understanding when they compare their own writing processes with those of others. Peer review may also lead to new perspectives as students decide to accept or reject peers' revisions (Mulder, Pearce, & Baik, 2014; Yang, 2010).

Reflection helps to move learning from the surface to deeper stages especially when working with others. Moon (2013) suggests that peer interaction can facilitate reflection. As discussed in Section 2.3, peer interaction will trigger doubtful, perturbation or cognitive conflict when students are interacting with others. If the learners experience doubt or perturbation, learners will become involved in the process of examining their experiences and deepening their thinking (Xie, Ke, & Sharma, 2008). Doubtful situations trigger reflection (Dewey, 1933). Reflection enables the learner to take a critical overview (Xie, Ke, & Sharma, 2008) to accommodate new information and to minimise the disequilibrium which pushes the learner into the higher order learning stage. Many scholars propose peer interaction as an effective way to promote student's reflective thinking skills. Peer interaction provides the opportunity of learners to externalise their reasoning and reflection on experience (Stickel & Trimmer, 1994). Moon (2013) also states that reflection helps to integrate learning into the cognitive structure and to reflect on the link to previous knowledge. In addition, communicating and sharing different ideas with each other can allow learners to easily access different points of view. The diverse perspective and information from others not only helps learners to gain an in-depth view of content (Yang, 2010), but also allows learners to assimilate and accommodate their thinking.

2.3.4.2 Action: Responses to anomalous data

Contradiction, conflicts, anomalies, erroneous information and discrepant events, can be viewed as anomalous data. Many researchers (Limón, 2001) have highlighted that there are different responses from individuals when faced with anomalous data (see Figure 2.4). How reactions are made when interaction with anomalous data occurs, depends on the individual's previous experience (Limón & Carretero, 1997). Prior experience is a very important variable to determine reaction. For example, if one child, without any previous experience about a specific piece of knowledge is provided with knowledge to fill that gap, then the child is unlikely to be aware that there may be a conflict with the information, because it is the first time they has been given such information. On the other hand, if one child has prior experience about a specific piece of information, then that child will know whether there is conflict or not, because of that prior knowledge. Piaget divided his theory into two different elements to illustrate the responses to contradictory information: the first is *Unadapted Responses* and the

second is *Adapted Responses* (Limón, 2001). Piaget illustrates that the Unadapted Response result is due to a lack of conflict with the specific information, in other words, the child is unaware that there may be conflict with the information being presented to him/her. On the other hand, the adapted responses represent the individual's response when they realise that there is conflict with the information, but decide to take different actions. Adapted responses are classified into three types: *alpha, beta and gamma*. Alpha means individuals ignore, or do not take into account, the conflicting data even when they know there is a conflict. Beta means individuals perform partial modifications in the learner's theory. Finally, gamma involves the modification of the central core of the theory. Some researchers (Chan, Burtis, & Bereiter, 1997; Chinn & Brewer, 1993) also propose a classification of an individual's reactions to contradictory information, or anomalous data. Chinn and Brewer (1993) highlight another seven types of responses to anomalous data: *ignoring, rejecting, excluding, and holding them in abeyance, reinterpreting, peripheral changes and change of theory*. Chan, Burtis, and Bereiter (2009) also elaborate upon a knowledge processing activity scale to evaluate individuals' reactions to the processing of contradictory information into five different levels (see Figure 2.4).

However, the result from Chinn and Brewer's (1993) study only focuses on what types of students' responses were when given students anomalous data rather than the responses from the peer interaction. There is some rare research that focuses on how students reacted when they were confronted with anomalous data during peer interaction. In Chan, Burtis, and Bereiter's (2009) study, they conducted research on 54 students in grade 9 and 54 students in grade 12 from Hong Kong, who were randomly assigned to four conditions: a) individual conflict 2) peer conflict, c) individual assimilation and d) peer assimilation. Depending on the conditions, students were asked to think aloud or discuss with their peers, and these were evaluated as to whether they maximised or minimised the conflict between new information and existing beliefs. Based on the results, it classified the responses as two major approaches to process contradictory information: direct assimilation, which involved adapted new information with what was already known, and knowledge building, which involved treating new information as something problematic that needed to be explained. However, Chan, Burtis, and Bereiter (2009) did not discuss how following responses that students take when they are treating new information as something problematic during the knowledge

building process. They only highlighted that some students continue to engage in explanation based inquiry and generate explanations to further the recognition of knowledge conflict without explaining it more fully. They also concluded from their results the importance of both conflict and constructive activity and they discussed the relations between them. The results also show that students in the conflict condition benefited more from peer collaboration than did those in the assimilation condition but overall quantitative results showed that not all students benefited from peer collaboration. Peer collaboration as described from this study is two students in a pair.

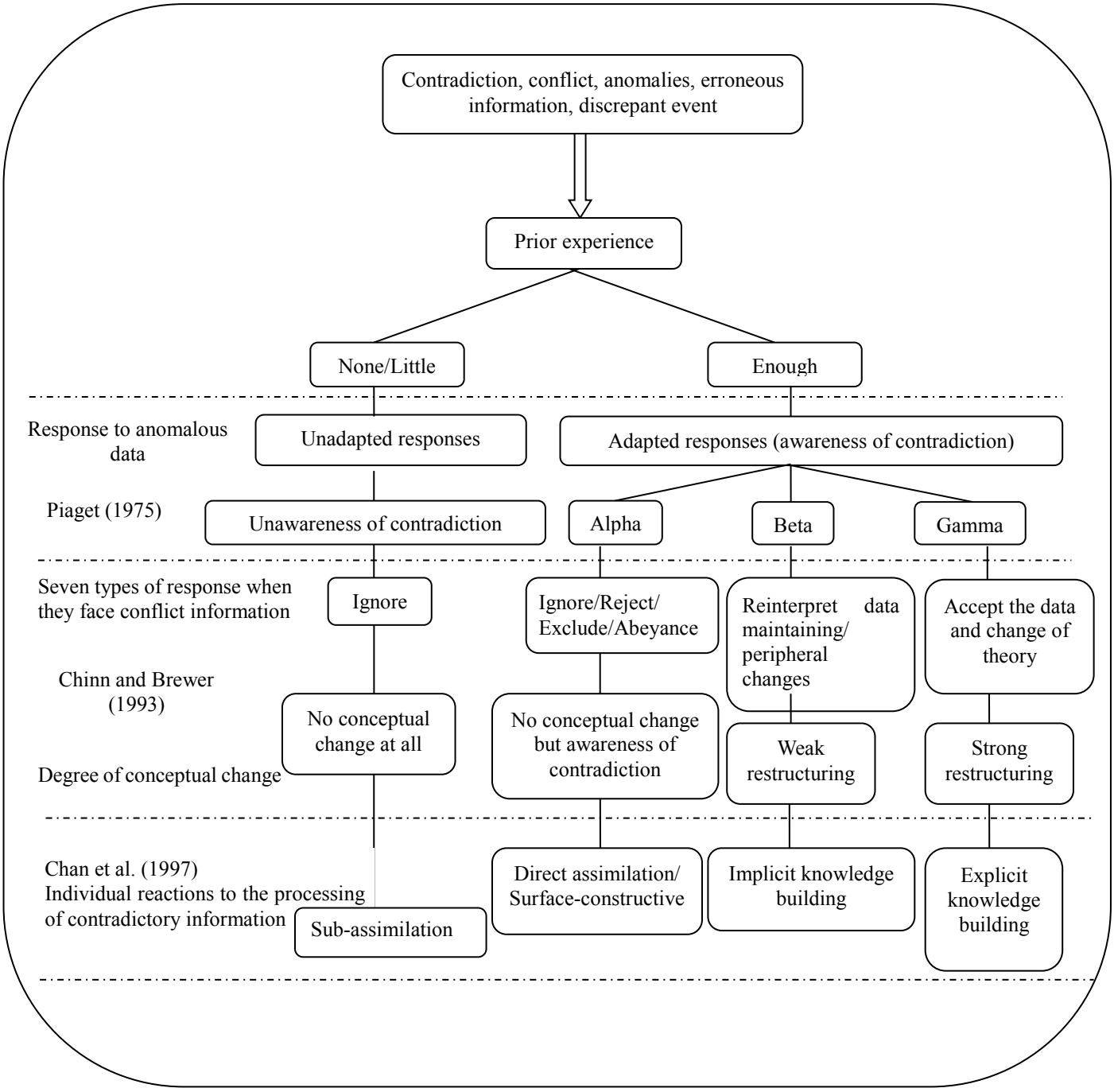


Figure 2.4 Reactions to anomalous data and degree of conceptual change (adapted from Limón, 2001)

2.3.4.3 Effectiveness of application of cognitive conflict

Cognitive conflict has different effects on children's understanding and learning. Whilst contradicting information is considered to be incorrect information or a misconception, such contradicting information can often lead to misunderstanding. This can create a negative feeling for the child, which can lead to children not sharing information. However, most researchers point out that cognitive conflict has an important role in conceptual change (Kang et al., 2005; Limón, 2001; Posner et al., 1982). Posner et al., (1982) agreed that conceptual change would be achieved by conflict, which is generated by dissatisfaction with existing concepts. Inconsistency among individual cognition and recognition of cognitive conflict when a child experiences disequilibrium would motivate individuals to attempt to resolve the dissonance and reorganise, restructure and change their existing concepts (Limón, 2001; Mogonea & Popescu, 2015; Piaget, 1985). Based on the result of increasing motivation from students to resolve the dissonance when they experience cognitive conflict, cognitive conflict is also applied as a teaching strategy to help students to achieve conceptual change in the science education context (Limón, 2001). Since the 1970s, science researchers have found that most students come with their preconceptions that are different from scientific conception (Lee et al., 2003; Pfundt & Duit, 1988). It is difficult to change their preconceptions by simply informing students of scientific conceptions. Cognitive conflict should be applied as a teaching strategy by presenting students with baffling demonstrations or paradoxes to increase their motivation to challenge their current preconception (Lee et al., 2003; Limón, 2001). Posner et al., (1982) show that students can only change alternative theories when they experience cognitive conflict and are aware of the existing problem. As Piaget (1975) suggests, the process of accommodation is only triggered when children recognise that something is wrong.

However, many researchers (Dekkers & Thijs, 1998; Lee et al., 2003; Strike & Posner, 1992) have argued that cognitive conflict is not an effective instructional strategy for children's learning because the child can often "patch-up" in a superficial way without reaching conceptual change (Kang et al., 2005). In addition, Kuhn et al. (1988) have suggested that most people, from children to adults, tenaciously cling to their existing beliefs, even in the face of disconfirming data. It has also been reported from controversial results of the application of merely presenting contradictory experiences

to students does not necessarily induce cognitive conflict (Chinn & Brewer, 1998; Kang et al., 2005)

However, Limon (2001) points out that although the application of cognitive conflict as a strategy does not make students achieve conceptual change, it may promote the first steps of the process of conceptual change. Inconsistency among individual cognition helps students to reflect more about their existing ideas to give an explanation to explain, and also possibly this reflection could motivate their curiosity to explore more information.

2.3.4.4 The role of socio-cognitive conflict in collaborative learning

As the role of cognitive conflict as the strategy to deliver conflicting information to students passively was not very effective, more researchers (Chan, Burtis, & Bereiter, 1997; Mason, 2001; Mogonea & Popescu, 2015) proposed that the collaborative learning context may be considered as the ideal source for promoting and resolving conflicts. The term of socio-constructivism has been applied to illustrate the process that learners promoted to resolve socio-cognitive conflict induced from the collaborative learning environment and interaction with others (Asterhan & Schwarz, 2009; Mogonea & Popescu, 2015; Zhang et al., 2007). Socio-cognitive conflict mainly focuses on the incongruence between two or more ideas and leads learners to reconsider, renegotiate and /or reconstruct this knowledge through argumentation or problem solving processes (Asterhan & Schwarz, 2009; Schwarz et al., 2007). In contrast to the cognitive conflict as the strategy focused on individual constructivism, social constructivism promotes the ideas of co-construction of knowledge, which leads to knowledge building processes through interaction with others (Mogonea & Popescu, 2015). There is a large body of existing research which focuses on how to use collaborative learning as the learning environment to promote argumentation, critical thinking skills and problem solving skills for students based on the socio-cognitive conflict they confront during the interaction (Chin & Osborne, 2010a; Chiu, 2009; Kapur, 2011; Mogonea & Popescu, 2015; Yiong‐Hwee & Churchill, 2007). Based on these existing researches, it analyses the different reactions that students performed that would contribute to problem solving and critical thinking, which thinking skills help students to review other students' contributions and reflect on their own understanding.

However, little work has been conducted to examine what reactions primary school students performed when they are involved in collaborative learning relative to cognitive conflict and how the role of cognitive conflict would contribute to collaborative learning to reduce the challenge of misleading other students' understanding during student-led discussions.

In summary, different perspectives pointed out by students could be the challenge that misleads students' understanding but also could be the strategy that induces cognitive conflict to increase students' motivation to resolve the conflict. Although the effectiveness of cognitive conflict as strategy to help students achieve conceptual change is still questionable, many researchers agree that the role of socio-cognitive conflict in a collaborative learning environment could promote knowledge construction to review conflicting information through reconsidering and renegotiating processes (Mogonea & Popescu, 2015; Schwarz et al., 2007; Skoumios, 2009). In the collaborative process, students with different conceptions interact together and may maximise socio-cognitive conflict, which would promote individual understanding. Students have to justify and clarify their position which helps them to review their understanding when they are exposed to the conflicting ideas from their peers.

In the following section, there is an exploration of how the role of technology can play a part in supporting Chinese students involved in active learning to interact with other students compared with Face-to-face learning environment.

2.4 The role of technology in peer interaction

Technology plays an important role as new means to encourage peer interaction and also to provide the learning platform for students to learn anytime and anywhere (Anastopoulou et al., 2012; Guiller, Durndell, & Ross, 2008). Computer Supported Collaborative Learning (CSCL) has emerged as a dynamic interdisciplinary and international field of research with focuses on how technology can facilitate the sharing and creating of knowledge through peer interaction and group learning processes. The aim of CSCL is to provide a learning environment that supports collaboration between students to enhance their learning process (Kreijns, Kirschner, & Jochems, 2003),

facilitate knowledge building and cognition reflection (An, Shin, & Lim, 2009; Yang, 2010)

In the following sections, there will be an explanation as to what benefit technology could provide to support peer interaction compared with face-to-face peer interaction. Secondly, there will be a review of the existing most popular technologies that researchers have applied and designed to support students' peer interaction and active learning. Thirdly, two concerns of designing technology for Chinese students in active learning will be addressed. Finally, the methods applied to evaluate students' learning online will be discussed.

2.4.1 Face-to-Face learning environment vs Technology supported learning environment

Although Information and Communication Technologies (ICTs) was promoted by many researchers as a new means of encouraging peer interaction and developing argumentation skills, there are still debates on the success of computer mediated groups compared to face-to-face groups (Guiller, Durndell, & Ross, 2008; Iordanou, 2013; Newman, Webb, & Cochrane, 1995). For example, the study conducted by Newman, Webb, and Cochrane (1995) compared face-to-face groups with online groups, focusing on the depth of critical thinking. They reported that similar depths of critical thinking in online and face-to-face discussions were identified after content analysis. However, more new ideas emerged in the face-to-face groups, whereas more ideas in the online groups were coded as important, justified or linked together. Newman et al. (1995) concluded that the asynchronous environment discouraged students from producing new ideas, but rather encouraged considered well thought-out contributions. Some researchers explained that computer mediated communication provides the opportunity for students to re-read and revise messages they contributed to and allow more time for them to think and consider their own response before responding which is all thought to encourage reflection (Asterhan & Eisenmann, 2002; Dong et al., 2008; Guiller, Durndell, & Ross, 2008).

Kamin et al. (2001) examined a small group of 27 students to evaluate asynchronous computer conferences as a substitute for face-to-face communication in small

groups. In their research the group of students were randomly assigned to either a face-to-face group or an online group. There were no significant differences in terms of overall students' performance as measured by final examination scores. However, significant differences were found regarding participation, with face-to-face groups reporting greater levels of participation. Furthermore, the online groups were reported to have contributed significantly more thought into comments compared to the face-to-face groups. Kamin et al. (2001) point out that putting more thought into comments in the online condition implies that the online environment does motivate the occurrence of reflection. The occurrence of reflection increased before responding may increase the quality of reactions to other students ideas (An, Shin, & Lim, 2009), which in turn facilitates higher levels of learning by offering the exchange of higher quality multiple perspectives (Lin, Hong, & Lawrenz, 2012). Some researchers (Iordanou, 2013; Yang, 2010) pointed out that it is also reasonable to assume that integrating and encouraging reflection and exchanging multiple perspectives through online discussions could benefit the joint construction of knowledge and development of students' thinking skills. For example, in Iordanou's (2012) research, he asked sixth grade students to engage in both face-to-face discussions and computer mediated electronic dialogue discussions with peers on a controversial topic. According to the findings of his research, it found that although the results showed limited abilities in arguing when students engaged in both the face-to-face and computer mediated discussions at the start, by the end of the study, the students showed significant advances in their electronic dialogues. Not only that, but the skills that the students improved upon in the IT environment can also be transferred into face-to-face discussions.

Compared to face-to-face groups, computer mediated communication not only provides an opportunity for student to reflect upon their current knowledge before responding to others, but it also allows for a larger quantity of students to participate in learning, thus increasing the opportunity for higher levels of knowledge construction. Moreover, the computer mediated communication has the potential for being more democratic compared to face-to-face groups (Howard, Barrett & Frick, 2010). As reviewed in Section 2.2.2., some researchers pointed out that Chinese students tried not voicing their different opinions and only reluctantly expressed their own thoughts in order to avoid criticism or to remain in harmony with their peers (Chan, 1999; Cheong & Cheung, 2008). However, Asterhan and Eisenmann (2002) highlighted that the anonymity of

online communication would increasingly motivate people to become less inhibited, therefore allowing them to self-disclose more frequently. Computer mediated communication may help Chinese students feel at ease in expressing their thoughts as they can do so without fear of losing face.

2.4.2 Existing technology designed or applied to support students' active learning

The previous Section (2.4.1) discussed the benefits that technology supported learning environment can provide to support students' learning in comparison to the face-to-face learning environment (Asterhan & Eisenmann, 2002; Guiller, Durndell, & Ross, 2008; Iordanou, 2013). This section will review existing technology tools designed for or applied to support students' active learning. There are various tools designed to support collaborative learning and argumentation for primary and secondary school's students in the existing literature (see Appendix I). Three main characteristics are identified based on the summary of existing technology supported collaborative learning tools. Firstly, some systems employed a visual representation of arguments which were contributed by students to scaffold argumentation and to show how they learnt how to argue (*Belvedere*: Suthers & Jones, 1997; *SenseMaker*: Bell, 1997; *Digalo*: Schwarz and Glassner, 2007; *Evidence-based dialogue maps*: Okada and Shum 2008; *CSILE/Knowledge Forum*: Lipponen 2000; *Factory talk*: Petrou, Kerawalla, and Scanlon, 2009). Secondly, some systems were designed to support students in conducting inquiry based activities and also to promote collaborative learning and discussion (*Metafora*: Dragon et al., 2013; *WebQuest*: Hou, 2009). Thirdly, most systems were designed to provide an opportunity for students to co-create and co-construct knowledge based on web 2.0 tools and social networking approaches (*CSILE/Knowledge Forum*: Lipponen 2000; *WebQuest*: Hou, 2009; *Blog*: Wang, Hou, & Wu, 2016; *Wiki*: Li, Chu, & Ki, 2014; *Online text construction system*: Yang, 2010; *Metafora*: Dragon et al., 2013). Although many systems (such as *Digalo* which provided good functionality for students to co-create the discussion content and also visualize their arguments to promote students' argumentation) have many functions this would reduce Chinese students' motivation to use them as they had little experience with using such collaborative learning tools. Therefore, web 2.0 tools and social networking

approaches (as highlighted in Table 2.1) were selected to review how technology could be designed for Chinese students' active learning. The key characteristics of web 2.0 tools are interaction, collaboration and contribution, which allows users to participate directly in the creation, refinement, and distribution of shared content (Gunawardena et al., 2009).

Technology	Key characteristics	Type of interaction	Relevant studies
Blog (Blogger)	• Share knowledge • Receive feedback • Derive social support from each other	Asynchronous online discussion (out of school)	(Wang, Hou, & Wu, 2016) (Yang, 2009)
Wiki	• Collaborative editing • User generated content enabling sharing • Co-creating • Co-construction of knowledge	Synchronous online (in class)	(Li, Chu, & Ki, 2014) (Fu, Chu, & Kang, 2013) Woo et al.'s (2011)
Online text construction system	• Trace result • Interactive • Peer review • Based on social constructive theory	Synchronous online (in class)	(Yang, 2010)
WebQuest	• Inquiry-led • Upload information • Sharing finding	Bridge learning from out of school to in school	(Hou, 2009)
Social network sites (e.g. Facebook)	• Learning through interaction and participation • Shared interests and information	Out of school	(Yang, Crook, & O'Malley, 2014) (Greenhow, Gibbins, & Menzer, 2015)
Forum (Q&A)	• Generate questions • Co-construct explanation • Revise ideas	Synchronous/Asynchronous online discussion	(Chan & Chan, 2011) (Cheong & Cheung, 2008) (Turcotte, 2012)

Table 2.1 Summary of reviewing existing technology tools applied to support students' collaboration and interaction

The use of blogs as a tool for learning has been widely applied to support students' collaborative learning techniques. Many researchers have proposed that blogs can be adopted as a form of reflective device which helps to promote collaboration, social knowledge construction and to improve engagement in active learning (Wang, You & Wu, 2016; Xie Ke & Sharma, 2008; Yang, 2009). Yang's (2009) research is an excellent example of this. 43 English teachers participated in the research project to use blogs to enhance their critical reflection. Yang's results positively implicated that the technology of a blog is a useful platform in enabling reflection and communication with others, thus helping the teachers to critically reflect upon their thoughts. However, all existing studies involved in applying blogs as a learning platform for students have focused primarily on higher education.

The use of Wiki as a tool for improving students' writing has been used in primary schools (Li, Chu & Ki, 2014; Woo et al., 2011). The key characteristics of wiki mean that students can collaborate in the editing process. Students can contribute their ideas and co-construct information with their peers. The process of co-creating and co-editing could help students learn from one another (Fu, Chu & Kang, 2013). Woo et al. (2011) used Wiki as a tool for scaffolding five primary school students collaborative writing at a school in Hong Kong. The results show that the students enjoyed using Wiki to improve their writing skills. Not only that, but the tracking functionality in Wiki allowed the students to reflect upon their existing problems in writing. However, the limitations for using Wiki with primary school students has been examined by Fu (2013) and Woo et al.'s (2011) studies. First of all, the students required training to familiarise themselves with the functions within Wiki. Most primary school students rarely have a need to use Wiki and similar platforms in their day-to-day lives which led to difficulties in their use of Wiki for the purposes of the study (Fu, Chu & King, 2013). Secondly, whilst the tracking functionalities could show where students had edited their work, they weren't able to evaluate or explain why they came to their conclusions (see Figure 2.5). The online text construction system that Yang (2010) developed to support students' collaborative writing was similar to that of Wiki, however, the online text construction system included peer review functionalities (see Figure 2.6). Based on the results of her study, the functionality of peer review could assist in inducing reflection during the collaborative learning process and also allow students to view their own text from the perspective of other students. Based on these perspectives they could make further revisions to their writing and, therefore, learn from one another.

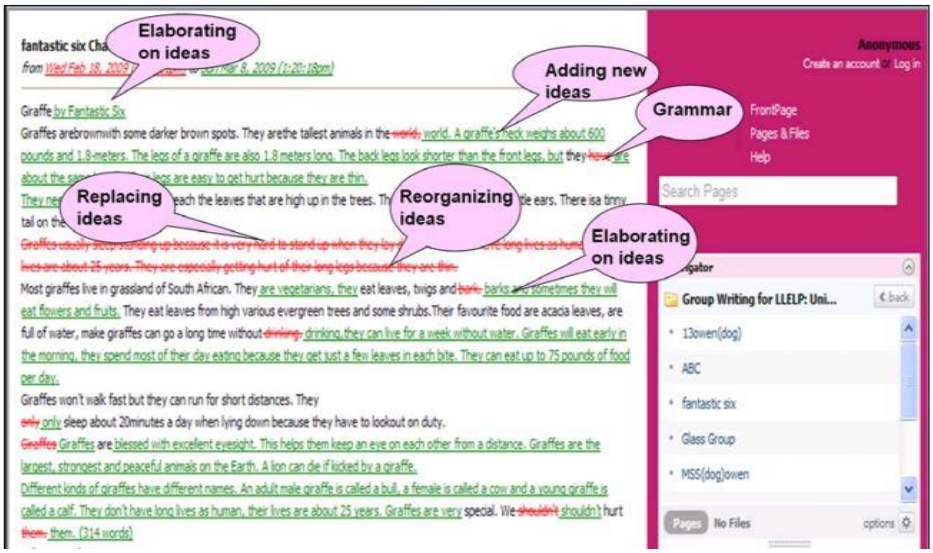


Figure 2.5 The interface of wiki software applied in Woo et al.'s (2011) study

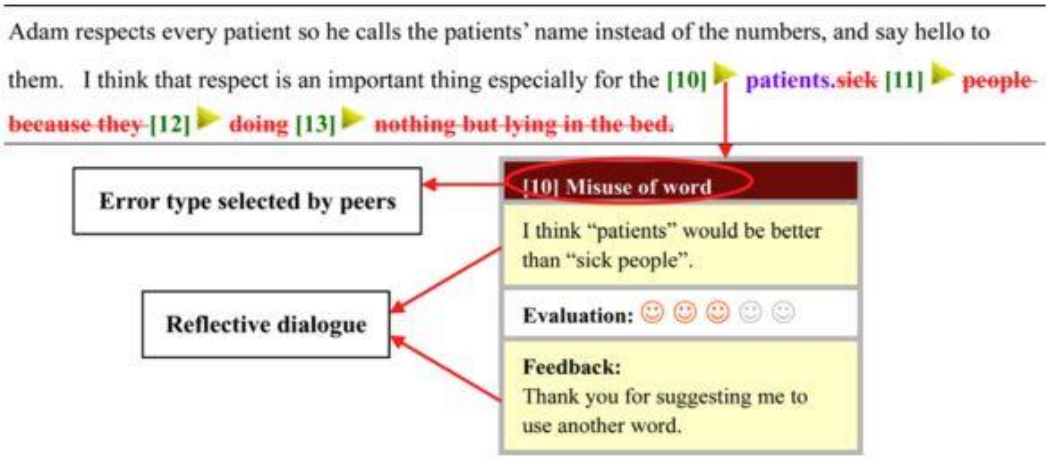


Figure 2.6 The interface of online text construction system in Yang's (2010) study

WebQuest includes functionalities similar to Wiki, blogs and online forums, which focuses mainly on inquiry based learning activities (see Figure 2.7). The function of the forum allows students to pose questions and discuss topics with other students. Teachers can upload learning materials through the function of the blog to enable students' learning. The use of WebQuest was applied by Hou (2009) to aid the learning of Chinese primary school students. The aim of her research was to reform the existing learning style of Chinese schools and to improve the communication and thinking skills of Chinese primary school students. Her results identified that Chinese students enjoyed the active learning style provided by WebQuest, however, they took longer to learn how to use the system. The limitations involved in this learning system were highlighted by this study. The many functions designed in this system reduced the students' motivation to use it as they took a long time to learn how to use the

program. The students had to have a certain amount of reading and computer skills in order to use the system. Also, Chinese teachers found that this system was time consuming for them as they had to take more time to find relevant information and upload it to the system for the students to read.

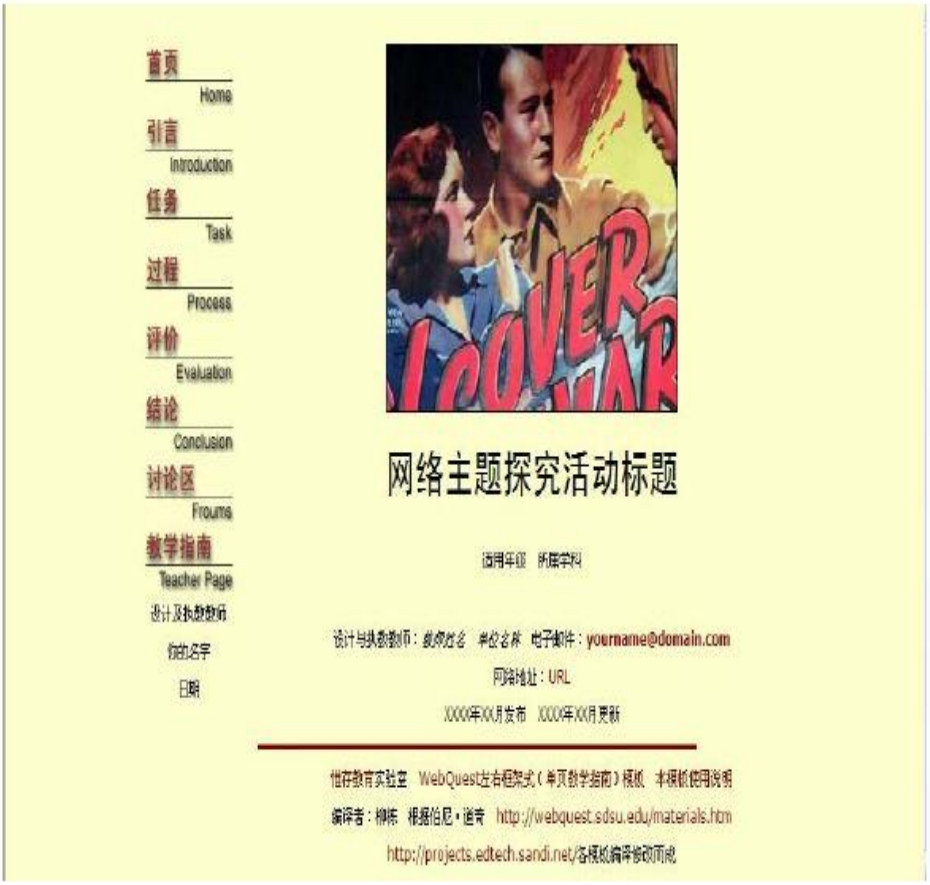


Figure 2.7 The interface of WebQuest which applied in Hou's (2009) study

Social networking sites such as Facebook can also be used learning tools to encourage inquiry and interaction amongst students. Y. Yang et al. (2013) conducted a study where seven children voluntarily attended after school classes to use social networking sites (SNS) for 12 weeks to learn Mandarin. The research findings showed that learning through social networking sites enriched the students' experience of learning the subject and also provided opportunities for the benefit from informal exploration.

Knowledge Forum was another learning platform widely used in asynchronous discussion and synchronous discussion in existing researches to examine how peer interaction would affect students' conceptual change and knowledge building (Chan, Lam, & Leung, 2012; Turcotte, 2012). For example, Turcotte (2012)'s research focused

on using asychronous collaborative conversation based on Knowledge Forum for grade five and six students to learn buoyancy. According to his findings, there is a significant conceptual change based on pre-and post test regarding students' answers of understnading of bouyancy topic. He also pointed out that asynchronous collaborative conversation make students have more relfection and thinking process on the comments contributed from peers compared with oral conversation.

It can, therefore, be concluded that most technologies used in these research examples are based upon the social constructive theory. The key characteristics of technology designed for students' active learning are user generated content enabled sharing, interactive and peer review. Based on the existing technologies involved with Chinese primary school studies, it is also possible to identify that these students enjoyed using the technology in order to generate questions and interact with other students. However, they have less experience using technology to support their collaborative learning and many functions used in the technology acts as a barrier to use.

When considering designing technology for Chinese students, two concerns should also be considered: the teachers' perception of integrating technology into education and E-safety for children. The following section will discuss these two factors in more detail.

2.4.3 Factors effect on designing technology supported learning environment for children

The previous section (Section 2.4.2) reviewed existing technology tools which were applied to support students' collaborative learning. It concluded that the basic main functions of contribution, interactivity and peer review should be considered when designing a technology supported tool for Chinese students. However, as discussed in Section 2.2.2, Chinese teachers play a prominent role in teaching strategies in class. Importance should be placed upon Chinese teachers' conception of integrating technology into education. Also, E-safety is an important issue to consider when designing technology for younger students. The following sections will discuss the conception of technology into education by Chinese teachers, followed by an explanation of why E-safety is important for younger students and how this factor impacts technology design.

2.4.3.1 Chinese teachers' conception of integrating technology into education

Whilst the design and implementation of technology is important in providing Chinese students the opportunity to ask questions and interact with others, the role of the teacher is also core in the integration of technology in the classroom (Sang et al., 2011). Existing literature highlights that there are two main barriers which have inhibited Chinese teachers from accepting technological support to aid students' collaborative learning in the classroom (Ertmer, 1999; Mumtaz, 2000). The first barrier is external (first-order), which mainly focuses on adequate access to technology, internet access, bandwidth and technology related training (Ertmer, 1999). However, based on the report from the Ministry of Education (2008), there are about 270,000 elementary and junior secondary schools in central and western rural regions that have been equipped with facilities that use contemporary ICT that helps teachers and students receive teaching and learning resources via the internet (Li, 2010). All schools had computer classrooms built and most were connected to the internet. Workshops and training sessions were developed to train around 100,000 Chinese teachers in how to use ICT to enhance their teaching in 2009 (Li, 2010). Therefore, it seems that the external (first-order) barrier would not be the main reason to explain why Chinese teachers are reluctant to accept the integration of technology in the classroom. Ertmer (1999) argued that teachers would not automatically use technology when these first-order (external) barriers were resolved.

The internal (second order) barrier focuses mainly on teachers' personal beliefs and philosophies regarding teaching and learning and how this would affect their attitudes towards using technology supported collaborative learning platforms (Mumtaz, 2000). The teacher's theory and beliefs regarding teaching and learning are veiled and deeply rooted in their daily practices (Ertmer, 1999, 2005). For example, Zhu et al., (2011) conducted research to identify how cultural differences would affect Chinese and Flemish teachers' perceptions of the implementation of ICT in teaching and learning. According to their findings, a small number (9 out of 60) Chinese teachers support the social constructivist principle and apply it during their teaching. Half of the teachers in the study agreed with the social constructivist principle but rarely applied it

to their teaching. Sang et al., (2011) set up the survey involving 820 Chinese primary school teachers to ascertain how teacher related variables affected the implementation of ICT in the classroom. The findings highlighted that the teachers' constructivist beliefs had an indirect relationship towards their attitude to integrating ICT into their teaching. As seen in Section 2.2.2, the main teaching approach adopted by Chinese teachers is that of transmitting information which is in stark contrast to the social constructivist approach. Chinese teachers did, however, agree that there is a certain value that technology can contribute towards teaching to compensate for the drawbacks of the lecture method (Zhao, McConnell & Jiang, 2009; Zhu, C., Valcke, M. & Schellens, 2010). For example, the introduction of technology supported learning into their teaching practice can benefit students in the process of learning (Zhao, McConnell & Jiang, 2009). Motivation can be improved upon by students using new technologies such as learning platforms and discussion groups to arouse their interest. However, they are still comfortable with their conventional lecture-based approach as their main teaching method (Zhu, C., Valcke, M. & Schellens, 2010). Teachers Highlighted two main reasons which causes them apply ICT supported collaborative learning in the classroom in a limited way; the nature of the class (class size for example) and the lack of time and resources (Zhao, McConnell & Jiang, 2009; Zhu, C., Valcke, M., & Schellens, 2010). There are, on average, 40 students in each class in China. Allowing students to presenting their own ideas and discuss ideas in a constructive manner would mean that teachers would not be able to fulfil their teaching requirements for that subject. Also, the concept of technology in network learning is in sharp contrast between China and western countries (Zhao, McConnell & Jiang, 2009). Technology in network learning is still referred to as a broadcast to deliver to the masses learning resources and materials rather than student-to-student communication and student-to-teacher communication. Moreover, the ability of students for self-study is also questionable. Teachers feel that most Chinese students are ill equipped with this style for learning and, in many cases, they still expect the teacher to feed them their subject. Chinese teachers also highlight that it is very difficult to shift methods from teacher-led towards more innovative methods for Chinese students, even in a face-to-face context (Zhu, C., Valcke, M., & Schellens, 2010).

ICT supported collaborative learning faces challenges from teachers' personal beliefs about teaching and learning due to the historical Chinese culture adopted in

education. Many researchers (A.-Y. Chen et al., 1999; Sang et al., 2011) highlighted that cultural perceptions need to be considered as a significant concern in the development of technology enhanced learning systems. Based on the current Chinese education background, the conventional lecture based approach is still identified as a central teaching and learning method. Technology supported collaborative learning for students out of class time should be emphasised to provide the social constructivist approach for students to avoid any conflicts with the conventional lecture-based approach. The finding of Sang et al's (2011) research concluded that when ICT is sued as a supportive tool for teachers to help prepare their teaching, thus helping to make them more willing to integrate ICT into education.

2.4.3.2 E-safety issues

It is essential that consideration is made regarding E-safety and how web 2.0 could support children in their online learning. The risks associated with web 2.0 activities are summarised into three main sections; inappropriate content, abuse of children and online bullying (Byron, 2007). Inappropriate content ranges from advertising to portrayals of violence that children can access can be potentially harmful to children. The abuse of children by adults through the internet is facilitated by social networking. For example, some adults pretend to be young children to encourage illicit relationships with them. Online bullying is on the rise and causes distress to children and their families as the attacks are constant and with the influx of smartphones, means that the child can be bullied in their home where they should feel safe. Li (2006) conducted a survey of 264 students from three junior high schools in Canada, the findings showed that almost half of the students were the victims of bulling. Philosophers of education from Rousseau onwards proposed that "walled gardens" should be created to support children to express themselves freely within a safe and supportive environment (Sharples et al, 2009). In order to understand more about E-safety in relation to social networking and media creation (web 2.0), Sharples et al., (2009) conducted interviews with 2600 students and 206 teachers. Based on their findings, it showed that 74% students used social networks (SN) and students engaged in social creative and web activities. However, concerns about internet bullying were identified with the research findings showing that a gradual process should be utilised to build trust and experience and that students should receive guidance on developing skills for social interaction and creativity on the web.

In summary, Chinese teachers play a very important role in whether to integrate technology supported collaborative learning into the existing teaching strategy. As discussed in Section 2.4.3.1, Chinese teachers are more willing to integrate technology into education if that technology is designed as a supportive tool to help prepare for teaching. Also E-safety issues should be considered when designing a technology tool for younger students. Adapting an existing social networking site such as Facebook for students would not be deemed as appropriate. Therefore, building a suitable and safe learning environment which includes simple, basic but important functions such as contribution to posts, reviewing and interaction is essential for Chinese students.

The following section examines the different existing methods and models applied to evaluate computer supported collaborative learning.

2.4.4 Evaluation of computer supported collaborative learning

Computer Supported Collaborative Learning (CSCL) has been widely applied in different research areas. There are various methodologies applied to evaluate the effectiveness of the application of Computer Supported Collaborative Learning. Pioneering research of computer supported communication focuses on the study of the more readily quantifiable variables in CMC such as participation and interaction (Hiltz, 1986; Kamin et al., 2001). Many researchers criticised this research by stating that quantifiable variables only can provide a rough analysis of communication rather than systematically examining the quality of learning in online discussions (De Wever et al., 2006; Henri, 1992). Henri (1992) stresses the importance of focusing on the quality of learning and of the learning interaction. There are various instruments proposed by researchers, which focus on the evaluation of computer supported communication research (De Wever et al., 2006). Based on various instruments proposed, a large variety of concepts are mentioned: cognitive and metacognitive knowledge and skills (Henri, 1992); critical thinking (Newman, Webb, & Cochrane, 1995); knowledge construction (Gunawardena, Lowe, & Anderson, 1997; Pena-Shaff & Nicholls, 2004; Schellens & Valcke, 2005). However, these instruments were widely applied to examine how students from higher education interact collaboratively online. There are two main perspectives that most instruments evaluate: participation and interaction. The

following sections, will explain how to evaluate these two perspectives based on the technology supported peer interaction and why these two perspectives are important to evaluate.

2.4.4.1 Participation

Participation is regarded as an important factor to understand the quality of learning irrespective of whether it's online or in face-to-face discussion, which has a positive effect on perceived learning (Hrastinski, 2008). Lave and Wenger (1991) point out that learning and participation are not separate activities that can be turned on and off. Participation can be viewed as active participation and passive participation, which are all regarded as social engagement. The following comments cited by Wenger are based on his perspective to explain the impact of participation. *''From [Wenger's] perspective our engagement with the world is social, even when it does not clearly involve interactions with others. Being in a hotel room by yourself preparing a set of slides for a presentation the next morning may not seem like a particularly social event, yet its meaning is fundamentally social. Not only is the audience there with you as you attempt to make your points understandable to them, but your colleagues are there too, looking over your shoulder, as it were, representing for you your sense of accountability to the professional standards of your community. A child doing homework, a doctor making a decision, a traveller reading a book – all these activities implicitly involve other people who may not be present." (Wenger, 1998, p. 57)* Hrastinski (2008) summarised the definition of online learner participation which is based on the review of the work of Wenger (1998) and Vonderwell and Zachariah (2005):"*Online learner participation is a process of learning by taking part and maintaining relations with others. It is a complex process comprising doing, communicating, thinking, feeling and belongiated communication with peers and teachers, and offline, e.g, by reading course literature. It moves beyond conceptualizing participation as writing by including terms such as doing and belonging.*" The pattern of online discussion has a many-to-many rather than a one-to-one form (Hrastinski, 2008). The pattern of the many-to-many form might benefit other learners from reading or listening to their peers once every participant joins in the discussion (Hrastinski, 2008). Laurillard (2013) suggests that the listener can feel the contributors' happiness, questioning and critical state almost all the time. It also shows that reading comments is not passively receiving knowledge from others,

which may encompass engagement, involving thought and reflection through reading others' contribution (An, Shin, & Lim, 2009; Hrastinski, 2008).

The common instruction applied by most researchers is the quantitative analysis method to measure the participation based on the number of messages posted during the discussion (Henri, 1992; Pena-Shaff & Nicholls, 2004; Weinberger & Fischer, 2006). De Wever et al. (2006) indicates that the level of participation measured by the quantitative method hardly helps to judge the quality of interaction.

2.4.4.2 Interaction

This section will discuss various instruments that are used by researchers to evaluate the quality of discourse in the Computer Supported Collaborative Learning research area. Henri (1992) points out that simply focusing on the quantifiable variables is not enough to evaluate the quality of the discourse. There are three main frameworks discussed from literature, which focus on evaluating the quality of knowledge of the constructivist principle during interaction.

The instrument of Gunawardena, Lowe, & Anderson's (1997) research is presented as a tool to examine the social construction of knowledge. The theoretical framework for this instrument results from the social constructivist principle. In contrast to other instruments, Gunawardena, Lowe, & Anderson's (1997) model focuses on how interaction induces the process of negotiating meaning and bringing about an understanding based on the shared knowledge construction principle. The series of phases used to represent the process of knowledge construction in the model of Gunawardena, Lowe, & Anderson's (1997). De Wever et al., (2006) highlights that the model of Gunawardena, Lowe, & Anderson's (1997) is most appropriate in social constructivist and collaborative (student-led) learning context.

Research from Veerman and Veldhuis-Diermanse (2001) also focuses on the constructivist framework in CSCL research field areas. They regard interaction which happens in collaborative learning based on the constructivist perspective as pedagogical methods, which can stimulate students to negotiate meaning and to discuss problems from different perspectives. They classified messages into two categories; task related

and not task related. The sub-categories of task related categories are divided into new ideas (content not mentioned before), explanations (refining or elaborating already stated information) and evaluation (critical views on earlier contribution).

Schellens and Valcke (2005) relate the theoretical position of both models of Gunawardena, Lowe, & Anderson's (1997) and Veerman and Veldhuis-Diermanse's (2001) (see figure 2.8). Schellens and Valcke (2005) used category 1, 2 and 3 in the instrument of Veerman and Veldhuis-Diermanse's (2001) which relates respectively to phase 1 in the instrument of Gunawardena, Lowe, & Anderson (1997). Category 1, 2 and 3 in the instrument of Veerman and Veldhuis-Diermanse's (2001) all represent new ideas involving facts, opinions and theory raised during the discussion which is similar to Phase One of Gunawardena, Lowe, & Anderson's (1997) model which focuses on sharing and comparing the information. Additionally, categories 2 and 3 relate respectively to phase two and three of Gunawardena, Lowe, & Anderson's (1997) model. In phase two of Gunawardena, Lowe, & Anderson's (1997) model, the focus is on discovery and exploration of dissonance or inconsistency among ideas, concepts or statements. This phase places emphasis on the disagreements raised during the discussion, which is similar to the cognitive conflict that people confront. Schellens and Valcke (2005) thought the process of this phase is similar to the explanation in the Veerman and Veldhuis-Diermanse (2001). However, in Veerman and Veldhuis-Diermanse's (2001) instrument, they only focused on refining or elaborating the already stated information which did not emphasise whether people disagree or not during the discussion. During phase three, the focus was more on the negotiation of meaning and/or co-construction of knowledge. It seems similar to the cognitive process of Piaget. Based on phase two, people may disagree or not, then they applied different actions to negotiate the meaning or co-construct the information together if they agree together, which is similar to the behaviour of evaluation. However, evaluation is only one of the negotiation behaviours during the discussion.

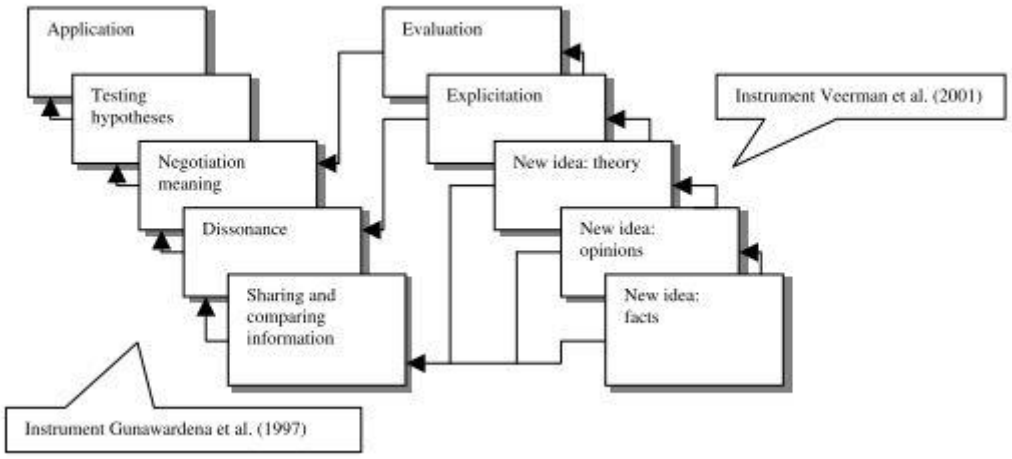


Figure 2.8 Schellens and Valcke (2005) relate the theoretical position of both models of Gunawardena, Lowe, & Anderson's (1997) and Veerman and Veldhuis-Diermanse's (2001) (adapted from De Wever et al., (2006))

The previous models discussed are based on the method of quantitative content analysis (QCA) which helps to reveal the distribution of process categories as the outcome to analyse the quality of interaction. However, it cannot reveal the relationship between each category. Interaction between learners would influence each other in subsequent discussions and reactions. The method of sequential analysis (Bakeman & Gottman, 1997) is another way to analyse the quality of interaction by revealing the students' behavioural patterns during online discussions. The sequential analysis method depicts the picture of how the variation of students' behavioural pattern contributes to the implication of application of each strategy for students' learning (Kapur, 2011). Numerous studies adopted this method to present students' sequential behavioural patterns in online discussions (Hou, Chang, & Sung, 2008; Jeong, 2003; Kapur, 2011; Weinberger et al., 2006). For example, Hou, Chang, and Sung (2008) researched the analysis of problem solving based on online asynchronous discussions to define the limitations raised during learners' problem solving discussions. They used methods of lag sequential analysis and quantitative content analysis to classify different reactions that students performed during the discussion to determine the significant pattern of students' behaviour online. The result of this research provided insight for them to evaluate the depth of students' discussion and knowledge construction. Jeong (2003, 2007, 2008) also conducted series research into observing students' behaviour performed during their interactions to examine whether the challenges students received from other students or their response to challenges from other students would promote further explanation and argument in asynchronous discussion.

2.5 Conclusion

This chapter has developed a literature review to unpack the research aim of this thesis, that is, to explore how technology can play a role in providing an opportunity for Chinese students aged 8-11 involved in new learning approaches to be active-critical-learners. Based on the research questions established in Chapter 1, this section explains the research challenges after reviewing the existing literature, with explanations of how they are explores in the following chapters of this thesis.

Do Chinese students aged (8-11) still engage in student-led discussion based on their Confucian hierarchy based background?

This thesis is interested in exploring new learning approaches for Chinese primary school students to have opportunity to join in active rather than by passively receiving their learning from teachers. As the first part of this chapter discussed (Section 2.2), a review of Confucian culture and teaching strategy as two key reasons effecting current Chinese students' behaviour as passive-obedient learners was carried out. Although most researchers applied Confucian culture as the key reason to explain why Chinese students' are reticent and resistant to the student –led learning approach (Chan, 2008; Chiu, 2009; Shi, 2006; Zhao & McDougall, 2008), some researchers pointed out that Chinese students have a strong desire to participant in a more student-led style of learning if given the opportunity (Cheng, 2000; Dong et al., 2008). Also, the viewpoints highlighted by the existing literature is based mainly on the results of empirical studies on students from higher education. Very few studies have been conducted to explore how younger Chinese students behave in the student-led style of learning. Moreover, in Section 2.3, using theoretical perspectives of peer interaction as the new approach, a discussion of how child-child peer interaction would benefit Chinese students in engaging in the reciprocal process of actively exploring and sharing each other's reasoning and viewpoints. Therefore, the first research challenge is to cautiously question the "participation of Chinese primary students" issues in the student-led discussion which is:

"Do Chinese primary school students aged 8-11 still engage in student-led discussions based on their Confucian hierarchy based background?"

The first study in Chapter 4 investigates how Chinese students participate in face-to-face student led discussions. It helps to reveal how Chinese students interact with other students and engage in the discussion. The second and third study in Chapters 6 and 8 also help to observe how Chinese students participate in technology supported student led discussions in class and also out of school time. To summarize, Chapters 4, 6, and 8 together revealed whether Chinese students engaged in the student led discussions in different activities based on their Confucian hierarchy based background.

How does cognitive conflict play a role in student-led discussions which leads Chinese students to challenge the inconsistency they confront and thereby enable them to become involved in the knowledge construction process?

This thesis is interested in how students interact with other students to build knowledge construction as the active learner in the student-led discussions. Section 2.3.3 highlighted that one challenge to such learning is that students will not be able to discern incorrect information shared by other students. However, Section 2.3.4 addressed that cognitive conflict will be triggered because they are confronting contradicting information when students review each other's contribution. In the following paragraphs of Section 2.3.3, it also addressed the issue that cognitive conflict would lead to students to performing different reactions to solve the conflict, which also can be regarded as the strategy to help students to achieve conceptual change. However, the effectiveness of this strategy was challenged by some researchers in Section 2.3.4.3. Section 2.3.4.4 argued that a collaborative learning context could maximize socio-cognitive conflict to promote individual understanding through different reactions which revealed a knowledge construction process. However, limited research shows that responses which students perform when they are involved in collaborative learning is relative to cognitive conflict and knowledge building. Therefore, the sub-question are about "*What types of reactions occur in a Chinese, student-led, face-to-face discussion? Which of these possible types of response are statistically significant and reveal significant patterns in the student-led learning environment?*" was generated to look at

what type of reactions students would perform during the collaborative discussion and how these reactions are relative to the knowledge building process.

The first study in Chapter 4 helps to observe how Chinese students interact with each other in the face-to-face learning environment. As Section 2.4.4 reviewed, the method of content analysis and sequential analysis tools are applied to identify what types of reactions occur in Chinese, student-led, face-to-face discussions. The further justification of why applying these two evaluation methods is discussed in Chapter 3. Based upon the reaction of students during the student-led discussion, could help to shed light on the role of cognitive conflict in the student-led discussion.

How can technology based intervention help to provide this stimulus and become accepted by Chinese teachers?

This thesis is interested in how the role of technology plays a role in supporting Chinese students' active learning compared with their traditional learning style. Section 2.4.1 highlighted the benefits such as greater reflection on students' understanding that technology can provide would affect students' interaction and knowledge construction processes compared with the face-to-face learning environment. However, limited empirical studies have been conducted to explain how technology supported collaborative learning effects younger students' interactive behaviour. Therefore, sub questions about "*How does the pattern of interaction differ between face-to-face discussions and online student-led discussions for Chinese students? How induced cognitive conflict could affect peer interaction and knowledge construction when technology based intervention applied?*" have been generated to compare and contrast how technology based intervention can help to provide this stimulus.

Section 2.3 mainly reviewed existing learning theories which underpin how new approaches can be designed to support Chinese students' peer interaction. Moreover, Section 2.4.2 reviewed existing technology tools applied to support students' collaborative learning. Further, explanations of technological design would be discussed in Chapter 5. The second study in Chapter 6 investigates how Chinese students interact with each other through technology based interventions. Chapters 4 and 6 together could shed light on how different patterns of interaction that students

have and how cognitive conflict effects interactions when they are engaged in a face-to-face learning environment and technology based intervention learning environment.

Section 2.4.3.1 highlighted another challenge to such technology supported student led discussion applied for students in existing Chinese education which is that Chinese teachers inhibit integrating such technological support for students' collaborative learning approaches within their existing teaching strategy. Therefore, the research challenge questions "Can student-led discussion as supportive tool be accepted by Chinese teachers within Chinese education background?"

The study in Chapter 7 highlighted how technology could be designed as a supportive tool to help with teaching and can aid students' collaborative learning based on teachers' perspectives. Finally, the study in Chapter 8 investigates how the role of technology plays a supportive tool in the blended learning environment.

3 Chapter Three Methodology

3.1 Introduction

The aim of this research was discussed in Chapter 1 and the research challenges were evaluated in the literature review. The current chapter seeks to explain how the methodology guided this research to solve the research challenges and achieve the research purpose. Firstly, it will introduce and justify the design based research methodology applied to guide this research. Then it will move explain the different phases of this research. Thirdly, it will introduce the research partners (Schools) who were involved in this research. Fourthly, the paradigm of a mixed methods approach including qualitative and quantitative methods as described in chapter 2 is elaborated. Finally, it will justify the data analysis tools applied to the data to answer the research questions.

3.2 Design-Based Research Methodology

Design based research is a research methodology introduced by Brown (1992) and Collins (1992), which aims to meet pragmatic research goals. This methodology was strongly influenced by Simon (1996)'s work. In his book, he regarded design as a science and explained the difference between natural science and sciences of the artificial. The position of the role of design science was promoted by him in the scientific agenda. The concept of design science was applied in educational research by Collins (1992) based on Simon's work. He explained that the role of natural science focused on understanding how phenomena in the world can be explained, which is similar to Simon's idea and the role of design science focused on determining how to design artificial behaviour under different conditions, which is also similar to Simon's idea of how we ought to learn. Based on this difference, the methodology of design based research was proposed to decompose problems and allowed researchers to proceed collaboratively with participants to achieve theoretical and pragmatic goals that would have notable impact on educational practices.

The aim of this research is to explore how to design new approaches for encouraging Chinese primary students (aged 8-11) to engage in the strategy of learning so that they

become active learners. Such an approach would also need to be localized in a Chinese, Confucian, hierarchy, and face based background. It is the pragmatic research goal to design the new approach which is supported by technology and finally can be accepted and localized in the Chinese education system. Such an aim matches the partial definition of design based research.

Characteristics of design based research (Anderson, Shattuck, & Brown, 2016; Collins, Joseph, & Bielaczyc, 2004; Wang & Hannafin, 2005) are discussed to justify why this research is not standard design based research but it is design oriented research conducted in the wild including pragmatic with mixed methods research. Design based research has been characterized as the theory driven nature (The Design-Based Research Collective, 2003). Based on the existing theory which helps to design the interventions, the process of an iterative cycle of design, implementation, analysis, and redesign are conducted to refine and improve both theory and practice (Collins, Joseph, & Bielaczyc, 2004; Wang & Hannafin, 2005). The current research did not exactly match this characteristic of design based research. Firstly, the findings of this research did not refine the existing theory but generated a new model which contributed towards the design of the intervention for supporting Chinese students' constructive learning in the second phase of the research. Secondly, the process of this research was not strictly an iterative cycle of design process to refine the theory and practice. As discussed in Section 3.3, there are three phases designed in sequential order to refine the system design and improve the practice. However, although this research did not involve an iterative cycle of design process and designed based on the existing theory, the aim of this research was to test a significant intervention which can be applied to support education based on a pragmatic research goal, which matches other characteristics of design based research. Firstly, this research was situated in a real world context. As highlighted by Collins (1999), one characteristic of design based research is to conduct research in the real world context with social interaction rather than in the laboratory setting with social isolation in order to test the intervention and gain feedback on practice. It can provide a sense of validity for the research and at least demonstrate that the design can effectively improve practice in at least one context (Anderson, Shattuck, & Brown, 2016). It is similar to the purpose of the research in the wild, which focuses upon observing and understanding how people really use and experience technological intervention in day-to-day life (Chamberlain et al., 2012). Secondly, mixed methods can

be applied to maximize credibility and adaptability of the study. This research used mixed methods in looking at the students' performance from different perspectives which helps to provide an enriched understanding.

3.3 Research Design

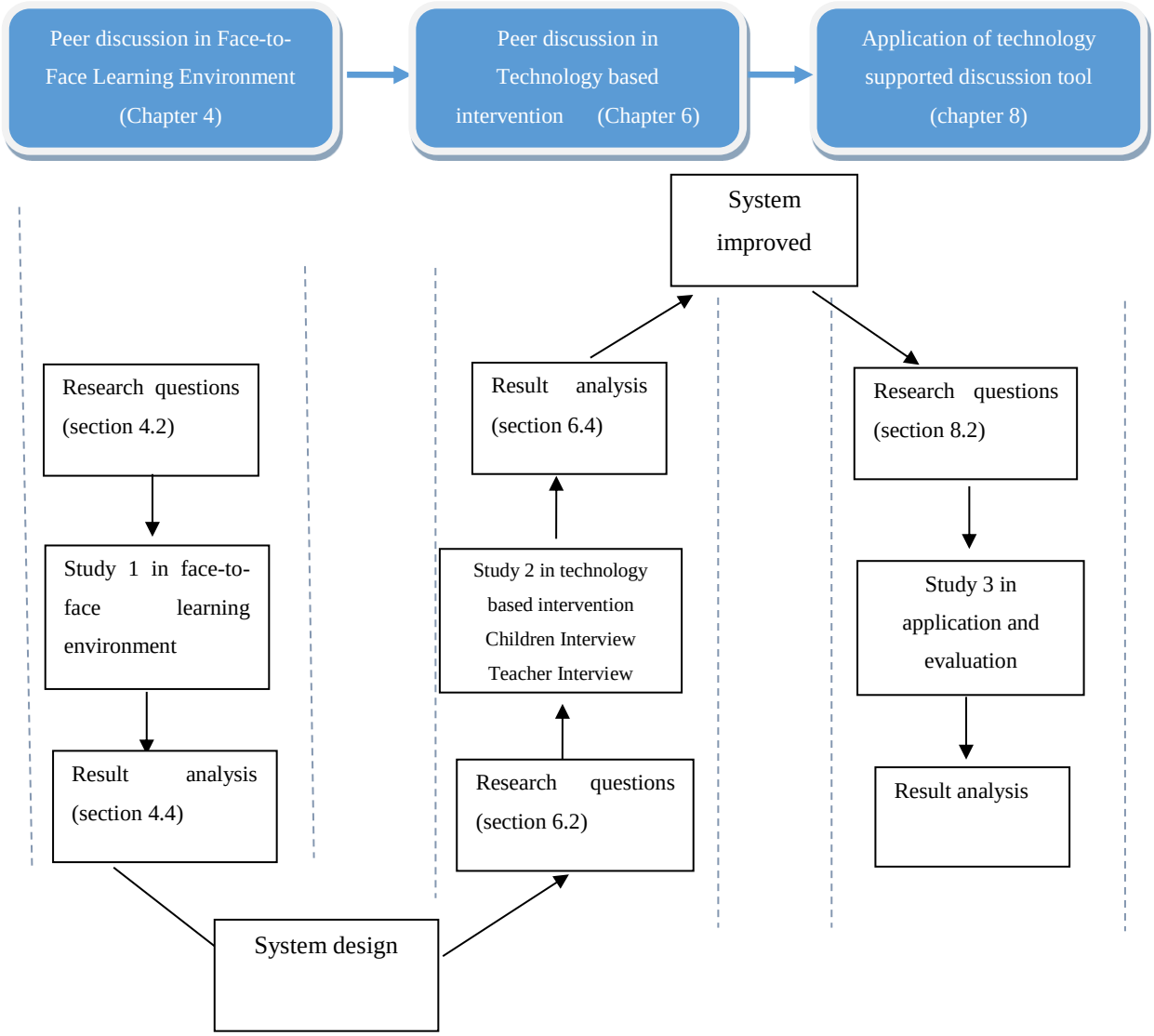


Figure 3.1 Different research phases designed accordance with research questions

Three different phases were designed which are illustrated in Figure 3.1 in sequential order. It is an interactive and iterative process used to refine the approach generated from the literature review, compare and contrast how the approach can be applied in practice and finally contribute to theory and practice. The mixed methods approach is applied in the different phases of this research based on the characteristics of design based research. It can help to analyse how intervention as an approach affects outcomes

and also could help to refine the intervention (The Design-Based Research Collective, 2003). Teddie and Tashakkori (2009) also recommend this mixed methods approach to explore and create a deeper understanding of prospective students' behaviour from qualitative research methods of quantitative findings. The following sections will discuss how and why the mixed methods approach was used in each phase of the work.

3.3.1 Phase 1: Face-to-Face Learning Environment

In the first phase of the research, the main purpose was to explore whether Chinese students engaged in student-led discussion as a new approach for their learning in the presence of their Confucian cultural background. In order to observe Chinese students' behavior the observation study was designed and conducted in the real world in a face-to-face classroom based context. This phase was carried out before implementing the technology supported student-led discussion platform. The findings of this study can contribute to answer the research questions proposed from research challenges revealed from the literature review chapter (see Chapter 2 Section 2.5). Firstly, it can provide the possibility of student-led discussion as new approach applied for Chinese primary school students. Secondly, it can also help to review the reactions that Chinese students had in the student-led discussion.

The mixed approach of data analysis techniques was applied to analyze the data. This will be justified in Section 3.5.

3.3.2 Phase 2： Technology based intervention

The first phase of the study was conducted to evaluate how student-led discussion worked as a new approach for Chinese students. Although the findings of the first phase imply the possibility of this new approach working for Chinese students in the face-to-face classroom discussion context, limitations were also found leading to the research in the second phase.

In the second phase, based on literature review of existing studies, technology was proposed as an intervention to support this student-led discussion for Chinese students. Chapter 5 explains the design of the technology intervention and explains the functions designed in order to combine them with the theoretical framework.

After designing and implementing the technology supported student-led discussion it was possible to further explore how a technology based intervention can help provide the stimulus to make different interaction patterns, challenge inconsistencies students confront and promote knowledge construction. It needed to be able to help students involved to avoid incorrect information spreading (see Chapter 6). This phase was conducted in three studies as illustrated in figure 3.1. The first study was an observation study to explore how students perform in the real world technology supported learning environment context. The second study consisted of interview to explore students' evaluation of this system based on three main purposes in this phase. Firstly, the students presented their learning experience on how *Agreement, Disagreement* and the *Confusion buttons* affect their reflections and the action taken. Secondly, the students were asked to evaluate the system based on the positive and negative influences on their learning experience. Finally, a comparison was made between the website that students usually use to solve problems and the designed online learning tool. The third study conducted used a questionnaire, which was a pretest of the students' understanding of the specific questions before the observation study. This was also used as a posttest after the observation study to see the change in the students' understanding of the same questions.

Furthermore, the interview was used to ask the students to evaluate the system's usability. Meanwhile, additional questionnaires were designed for the students to evaluate the system based on the participation, interaction, learning experience and motivation (presented in Chapter 7).

The mixed approach of data analysis techniques was applied to analyze the data collected from the observation study to reveal students' reaction. The qualitative approach of data analysis techniques was used to analyze the data transcribed from the interviews. Data collected from the questionnaires was analyzed using a quantitative data analysis approach.

3.3.3 Application of Technology Supported Discussion Tool

After reviewing how technology supported student-led discussion as a new approach for Chinese students affected the participation and interaction in the first two phases, the main purpose of phase 3 was to explore how the new approach could be accepted by teachers localized in the Chinese system as highlighted in the research challenges and literature review.

This phase was conducted in four parts to explore how to refine the intervention and apply it in practice. The first study was a set of interviews conducted with the teachers to explore what their attitudes were to this intervention provided for students' learning (in Chapter 7 Section 7.3.4). Based on the result of teachers' interview, the new extended functions will be designed in the system. The observation study of how this new extended system applied for students and teachers will be investigated (in chapter 8). Two interview studies were conducted after the observation study to explore how this application affected the students and teachers when compared to their traditional learning and teaching experiences (in Chapter 8).

The final process was to combine the findings from all of the phases and produce conclusions. This combination of phases was necessary to enable refinement of the intervention for Chinese students in educational context to provide a comprehensive understanding of the how the technology based intervention could be applied in the practice.

3.4 Research Partners

The research was designed to focus upon Chinese students aged 8-11 years old for three main reasons: Firstly, most literature pointed out that Chinese students were regarded as passive-obedient-learners. They normally keep silent and avoided arguing with others in classroom discussions. However, the previous studies all focused on students from high school and higher education. Rare empirical studies researched how Chinese students performed in primary school. It is important to develop a new approach for Chinese students, especially for younger Chinese students to have the opportunity to ask questions and share their ideas with others.

Secondly, the literature suggested that children do not develop suitable cognitive skills to evaluate information received from others objectively, until they are eight years old. Around this age, students master certain skills to enable the social analysis of consciousness, and can understand and analyze the information they gather from others. Piaget (1956) also agreed that children aged eight years old begin to develop a more inductive ability when compared to younger children. The study did not include year 6 and seven students because in China these years lead to important examinations and it was necessary to avoid interfering with the preparation process.

Finally, this research also involved students interacting with computers so that they could communicate with each other. Students needed to have certain abilities for typing and in China students start to learn to type from 8 years old.

3.4.1 The Education System in China

The Chinese government provides 9 years of compulsory education beginning at age 6 and ending at age 16. The target participants in this research were from 8-11 years old, corresponding to years 3 to year 5 in the Chinese system. There are two common types of schools in China: the state schools and the independent schools. The state schools are funded and administered by the education sector within the government. The admission for students to state school is based on their home address and whether they are in the catchment area. Meanwhile, independent schools are funded and administered independently. There is no catchment area requirement and fees need to be paid by the students' families. However, the assessment would apply to the same age range of students, whether they went to a state school or to an independent school. There are no league tables and a school's reputation is purely based on academic achievement.

3.4.2 Schools Involved

The 3 schools which were selected for this research were chosen because the students were able to attend all 3 phases of the study. The Schools – referred to as A, B, and C – were all from Hangzhou, China. School A was an independent school and the other two were state schools. The schools were located in different areas of Hangzhou. As mentioned before, the students in the state schools were from the catchment area of their home addresses. However, the students in School A were from different areas and even

from different cities. In addition, School A was a boarding school where students often go home only once per week. Although there was no specific league table showing the reputation of these schools the parents identify which is a 'good' school and which may be a 'better school' based on what they consider their reputations to be. They ranked the schools as follows: schools A and B were good and school C was outstanding.

3.4.3 Science Topic Involved

The topic adopted in this research was a science topic from the school curriculum. There were 2 main reasons for choosing science as the topic for this research. Firstly, this research focused on how cognitive conflict induced from peer interaction affects knowledge construction. Based on the literature review most students will have preconceptions that would cause problems when they are learning science (Driver, 1985; Lee et al., 2003; Pfundt & Duit, 1988). Since the 1980's, many science researchers tried to use teaching strategies that present students with baffling demonstrations or paradoxes to increase their motivation to challenge their current preconceptions (Watkins & Biggs, 1996). Posner et al., (1982) pointed out that students can only change theories when they experience cognitive conflict and are aware of existing problems. Therefore, using a science topic was likely to produce cognitive conflict during peer interaction. The topic was chosen to see whether alternative answers from others and negotiating with others would challenge their preconception. Secondly, the main purpose was to make students learn science effectively by providing opportunities for them to enquire, hypothesize, argue and negotiate with others (Prain & Tytler, 2012). The approach proposed in this research is therefore similar to this style of enquiring, hypothesizing and negotiating for science learning.

3.5 Research Methods

In this section, mix methods (use of both qualitative and quantitative methods) are discussed, followed by an explanation of the ethical issues of each method.

3.5.1 Observation study in real world context

Three observation studies were conducted in the three different phases to observe how the interventions affected the students' behaviour in a real world context. Although observation studies conducted in actual learning environments, such as a classroom or

after school setting can easily lead to loss of control of variables which may affect the success of the design (Collins, Joseph, & Bielaczyc, 2004), they can provide the opportunity to gain rich understandings of the phenomenon of how exactly students behave within social interaction rather than a laboratory setting with social isolation (Collins, 1999). This is also consistent with the characteristics of design based research. In contrast, in a laboratory setting experiments could help to students to concentrate on the task without any distractions allowing greater control of variables and more fixed procedures to be used. However, the main point of the current research was to explore how to design an approach for Chinese students which could be localized in the Chinese education system in practise. The results from a study conducted in a strictly controlled learning experiment may not contribute to developing a qualitative and quantitative profile that characterizes the design in practice. Therefore, the observation study was conducted in real world context in order to understand how exactly this approach would affect Chinese student' behaviour. In the following sub sections how each observation study was conducted including orientation, sampling procedures employed, ethical issues, data analysis adopted and the location of the method within the overall research design will be presented.

3.5.1.1 Observation study in the first two phases

In order to evaluate how Chinese students naturally behave in the student-led face-to-face discussion an observation study was conducted in the first phase. 380 Chinese student aged 8-11 selected from three schools (A, B and C) attended this study.

During this experiment video recording of the students' behaviour and reactions was used. There are two video cameras set during the experiment. One video was set in the front of students, and the other video camera was set behind the students. The video recording enabled review of how many students participated in the experiment and the observation of their behaviour. In addition, the video resource also was transcribed and this was then used to analyse the different reactions that students performed. The mixed methods of content analysis and sequential analysis were applied to analyse the data collected from this study, which will be discussed in detail (see Section 3.6). This process was repeated for Phase 2 where the technology supported learning environment was used. Ethics approval was given for both studies and this is discussed in detail in

Section 3.5.5. The same data analysis methods were applied to analyse the data to keep consistency.

3.5.1.2 Observation study in out of school time learning environment of third phase

As previously explained, the purpose of the research design of the third phase in this research (see Section 3.3.3) was conducted out of school time. In contrast to the first 2 methods it was not only the students who joined the student-led discussion but also questions were posted by the teachers and were from the science curriculum. One class of students from school C was preparing for a competition so these (40) students did not partake in this third phase. The data from the study was collected and summarized. The teachers then explained and extended the information summarized from the online discussion during their classroom teaching. The teacher participated in the student-led interaction during the blended learning environment experiment of the third phase. Ethics approval was again obtained and is once again detailed in Section 3.5.5. The same data analysis methods were applied to analyse the data to keep consistency with the first two phases.

3.5.2 Interview

The method of interview was selected as appropriate for this study because an interview can help the investigator to gain a deeper understanding of how different learning environments affect an individual's learning experience - something which cannot be captured through observation (Patton, 2005). Merriam (2009) supports this view in that the method of interview can help researchers gather specific kinds of information and explore what the participants' thoughts were. In Sections 3.6.1 and 3.6.2, the quantitative method and content analysis method of collecting data from the experiments to evaluate the participation and quality of interaction amongst the children was described. It was difficult to know how the students' learning experience had been affected by their learning in the 3 different phases and therefore the interview method was seen as a suitable approach, especially when observation was not possible.

The semi-structured interview is one of many interview techniques. There are two reasons for selecting this method. Firstly, this kind of approach allows for the discovery,

or elaboration, of information that is important to participants but which may not have previously been thought of. The current research was about the perception of Chinese children on how technology affects their learning experience – one of the main gaps in the current literature. The semi-structured interview can be used to help the participants recall their experiences and develop a new theme about their learning experience. Secondly, this approach not only allows participants to express their perceptions and reveal their experiences, but also provides both the researcher and the participants with the ability to clarify their meaning. There were 2 limitations when conducting interviews with children. Firstly, the interview needed to be developed very carefully, especially academically, because of the use of language. Sometimes, the students might use their own type of language to describe their thoughts and feelings and possibly questions may require much further explanation. The semi-structured interviews offered further opportunities to give the students more probing questions in order to encourage them to answer the questions by digging into their experiences. Additionally, in a one-to-one interview situation, students aged 8-11 years are normally quiet and less willing to share their experience. Secondly, it is time consuming to conduct interviews with 54 students. However, based on the purpose of the interview, it was not suitable to conduct a focus group as the method to explore the evaluation of the system and the 3 buttons designed in the system. The method of the focus group would affect the answers from each individual interviewee from the groups.

As explained in Section 3.3, there were 2 studies that involved the interview process. One was used to examine the 3 aims for the children (evaluation of system, evaluation of 3 buttons and compare and contrast an existing similar system that the children used). The second was used to interview the teachers. The reason for this was based on the results of the interviews with the children. The children mentioned that the role of the teacher in the learning environment was important to them. In order to explore the situation from the teacher's perspective the study was re-designed.

3.5.3 Focus Group Discussion

The focus group was selected as a research method rather than individual interaction in the third phase due to the limitations of the individual interviews applied to the children. Firstly, individual interviews made some children quiet and they kept silent. Due to the

different personalities of the interviewees, some students present their points very naturally, but some students feel discomfort and are nervous when answering the questions. Secondly, one-to-one interviews can be very time consuming. Although only 6 students were selected from each class per year, there were still 54 interviews which had to be undertaken. During the third phase of the experiment, the school was unable to allocate a lot of free time for the interviews to take place, and if the amount of time taken to interview a student on a face-to-face basis was reduced, it would impact upon the quality of the interview. Therefore, the one-to-one interviews were changed to a focus group.

After applying this approach of a focus group to the experiment, it was noted that the students were not as apprehensive and actively began to share their ideas amongst their classmates. Many researchers (Gibson, 2007; Horner, 2000) agree that focus groups are a more suitable way to identify information and data if children are involved in the research because it provides them with a more familiar environment where they can interact freely with their peers. However, the disadvantage of a focus group demonstrates that this kind of interaction can be dominated by the stronger characters of a group and therefore those who are less dominant may not have an equal say or get their opinions across as easily (Robson & McCartan, 2016). During the process of the focus group, the researcher tried to ask every participant in the group to present an idea. This then helped to avoid the dominance of a single person. The focus group discussion offered the researcher a further opportunity to explore the participants' thoughts through their interaction with others (Mertens, 2014).

The size of a focus group is typically composed of 5-8 people. For this study, the size of the focus group was 6 students who were selected based on their online interaction behaviour and who were from the same class. Different characteristics of the children's online interaction behaviour from the same class helps to provide an evaluation of the how the application of the technology supported discussion out of school affected their learning experience.

3.5.4 Questionnaire

The method of a questionnaire was selected for three reasons. First, the questionnaire was applied as a pre and post-test to evaluate whether students' understanding level changed or if they had been misled by incorrect information after the online student-led interaction. Secondly, the questionnaire included 10 statements that describe different aspects of the students' personal experience during the discussion phase. The main aspects that the questionnaire accessed were interaction, participant learning experience, clarity and cognitive conflict. It helped to gain more understanding of the impact on users by asking them to self-report.

The main reason to choose the method of questionnaire as appropriate for achieving the purposes is because the questionnaire can help to gather more in-depth insight into participants' thoughts and actions for a large set of students in a short time (Atkinson, 2008). It is very challenging and time consuming to conduct interviews to gain in-depth insight about each participant's thoughts based on the large scale set sampling. Additional, external constraints such as examination and school holidays also limited the opportunity to conduct the interviews in different schools. The method of questionnaire is a good way to collect the data from a large scale set of students and gain a better overview from all of the participants regarding in-depth thoughts and actions.

Based on the purposes of the questionnaire applied, quantitative data analysis techniques were applied to evaluate the data which will be discussed in the Section 3.6.

3.5.5 Ethical issues

The consent forms were used in Chinese are shown in Appendix II and were delivered to teachers to explain the procedure of the experiment and get agreement from parents and students before conducting each and every part of the study. Additionally, according to the guidelines of the University of Nottingham, all data collected from the observation studies must be confidential and anonymous. Furthermore, the participants or each participant's parents had the right to withdraw from the study at any time should they wish to do so. The data was stored in accordance with the Data Protection Act. No

children were identifiable from the data and the data was only be used for the purpose of this research.

3.5.5.1 Ethical issues in observation study

During the observation studies conducted in phase two and three (students involved with online collaborative learning), to make sure that the children were secure whilst working online, only the participants were allowed to log into the learning environment. Without providing usernames and passwords, other people were not able to log onto the website. This security measure was put into place so that the researcher could easily identify whether or not other users had accessed the website without permission. All of the users' names were anonymised on the website and no children were identifiable from the website.

3.5.5.2 Ethical issues in interview study and focus study

Before each interview with a child the child was briefed as follows: "Thanks for helping me. I will ask some questions about your experience with the experiment you have just done. In order to review our conversation, I will audio record our discussion. Are you OK with this?" the interviewer then waited for the children's feedback. All the children agreed with and were comfortable with the audio recording. After the children replied, the interviewer continued, saying that "our talk will be totally confidential, which means only I will listen to it and if I quote your answers, it will be anonymous. Also, if at any time during the interview you want to stop or skip a question, feel free to do it." In fact, no child asked to leave or skip any question. At the end of interview, the interviewer gave contact details i.e. name and email to the children, and the children were told to contact the interviewer if they needed to.

3.6 Data analysis

In Section 3.5, justification was developed as to why and how the mixed methods (both qualitative and quantitative methods) approach was adopted in order to answer the research questions at different stages. In this section the various data analysis techniques used in order to obtain the results for this research are justified. The purpose of the research was to provide the opportunity for Chinese elementary students (aged 8-11) to ask questions and to participate in the discussions generated during the different

learning environments presented. This then allowed for student-led interaction, and for a comparison to be made between the different learning environments that would affect their quality of learning. The quality of learning was evaluated from three dimensions: participation, interaction and learning experience (cognitive). The participation of the students was assessed by the quantitative data analysis method. This research uses content analysis and sequential analysis to present the results and to illustrate how different the children's reactions are; how their behavior differs and how the pattern of these reactions relate. Finally, the learning experience was evaluated based on the interview, the questionnaire and the focus group responses. The qualitative data analysis method of thematic coding was applied to reveal the theme from the children's own experience.

3.6.1 Qualitative analysis

3.6.1.1 Content analysis

Content analysis, as a technique, has been widely applied to analyse transcripts from Computer Mediated Communication (CMC), to Computer Supported Collaborative Learning (CSCL) research (De Laat et al., 2007; De Wever et al., 2006; Newman, Webb, & Cochrane, 1995; Rodriguez, 2014; Schrire, 2006). The common themes of these environments are the focus on the student's exchange of messages with one another through computers. The main purpose of the content analysis is to reveal information that is not situated at the surface of the transcripts (De Wever et al., 2006). Surface transcripts have been widely measured by many researchers when they have applied a quantitative approach. For example, participation was evaluated by how many messages the user posted, and the average length of each piece of information was seen to be proportional to the quality of the content (Hrastinski, 2008). However, these quantitative variables can only provide a rough analysis of the communications rather than the systematic examination of the quality of learning in online discussion (Gunawardena, Lowe, & Anderson, 1997). Meyer (2004) agreed that it is hard to justify the quality of an interaction by only showing the number of student contributions to a discussion. Additionally, the quantitative approach cannot reflect the complexity of the peer interaction and provide an in-depth understanding of the interpretations of why certain behaviours occur during the interactions (Mason, 1992). The characteristics of content analysis are that they help to reveal in-depth information about learning and

knowledge construction, which is below the surface of the discourse in the transcripts (De Wever et al., 2006; Henri, 1992). The content analysis approach can provide an interpretation that Cronbach (1975) called *in context*, and explains what happens between the interactions in a given context, in other words, how the interactions take place and why they occur (Merriam & Tisdell, 2015). Based on the advantages of the content analysis techniques, there are 2 reasons for selecting this as this approach to data analysis. Firstly, content analysis has been widely applied in the evaluation of computer supported collaborative learning research areas (De Laat et al., 2007; De Wever et al., 2006; Newman, Webb, & Cochrane, 1995; Rodriguez, 2014; Schrire, 2006). In this research study, although the study in the first phase was in a face-to-face learning environment, it has one thing in common with the other phases which is that the students can exchange messages through discourse with one another. The studies in the second and third phase both involved computer supported collaborative learning.

Secondly, in this research study interest is not only in how many different comments and questions the students post in the different learning environments, but also on the quality of the messages that the students post. For example, on a micro level of interaction it will be useful to find out what kinds of different reactions the students have in the different learning environments. In addition, it is also necessary to define what the different reactions are and whether the students confront cognitive conflict, and how the different reactions occur and why. Merriam (2009) suggest that qualitative methods help to focus on what happens in a given context; how the events take place and why they occur. Thus, there are 3 main challenges involved in the approach of content analysis: unitization, establishing categories and coding and, finally, the issues of reliability.

3.6.1.1.1 Unitization

The unit of analysis helps to reveal the overall picture of the content of what the children discuss and how it can then be broken down into meaningful units for coding based on the analysis categories. The choice of the unit of analysis plays an important role in the accuracy of the coding to reflect the true content of original discourse (De Wever et al., 2006). There are various approaches for the unit of analysis, such as sentence unit, thematic unit and message unit (De Wever et al., 2006). The thematic unit approach has

been selected as the unit of analysis here to establish categories for analysis. The aim for this study was to find out how many different reactions the children would make during the discussion relative to whether cognitive conflict and exploratory talk has occurred. The variable being investigated should be relative to the theme. The thematic unit approach is appropriate for this research as it defines the characteristics of the children's reactions during the discussions. Henri (1992) applied the "unit of meaning" to his research. Schrire (2006) also highlights that data can be coded more than once and the grain size of the unit of analysis is set depending on the purpose and the research question.

3.6.1.1.2 Establishing categories and coding

Inductive Category Development and Deductive Category Application are central to the procedure of content analysis. The deductive approach is derived from categories from the research hypotheses and theoretical framework, in a top-down manner. On the other hand, the inductive approach is a bottom-up manner, which establishes the categories arising from the data (Chi, 1997; Lampert & Ervin-Tripp, 1993). The different approaches adopted in the coding would affect the coding scheme established. There are 2 reasons for selecting the hybrid approach (the deductive and inductive) in this study, because the use of both approaches helps to establish the categories and analyze the data. Firstly, much of the literature in this field of study (De Wever et al., 2006; Rourke et al., 2001) suggests that researchers use an existing coding scheme that has been developed and used previously by other researchers rather than develop new coding schemes. The process of applying existing schemes fosters a reliability and validity to the instruments (Stacey & Gerbic, 2003). Based on the existing content analysis models that other researchers have applied, De Wever et al. (2006) compared and reviewed 14 different content analysis schemes, which were applied in the evaluation of different aspects of students' learning, cognitive learning and social perspectives. These 14 different models were created using different theoretical frameworks. After comparing and reviewing these different models, Gunawardena, Lowe, & Anderson's (1997) model, as the reference for building a coding scheme, has been chosen as the tool to analyse the data collected during the investigation process of this study.

In Chapter 2 Section 2.4.4.2, an explanation of Gunawardena, Lowe, & Anderson's (1997) model is presented in detail. The main reason for choosing Gunawardena, Lowe, & Anderson's (1997) model is its relevance to the purpose of the current research, which involves social constructivism, knowledge construction and (to a lesser extent) cognitive conflict. The application of a deductive approach for coding the transcripts (translated from the children's discussion at beginning of each of the 3 phases) has highlighted that if Gunawardena, Lowe, & Anderson's (1997) coding scheme was applied it could not satisfy all of the proposed categories from the data. The limitation for that existing coding scheme was the lack of an identification of the categories due in part to the different research partners and research hypothesis. The existing model was able to evaluate the different behaviours that users had during the interaction and the discussion period and how these behaviours reflected the different stages of the knowledge building. However, the research partners in the current research were different to those for whom the earlier model was developed. For example, the model initially adopted as the coding scheme focused on higher education students, but for the research sampling the focus was on primary school students. Due to the age differences, the behaviour they present would be different to those in the earlier study. The initial model also had a limitation of the content analysis that Rourke et al., (2001) highlighted. They pointed out that "*this lack of replication (i.e., of successful application of other researchers' coding schemes) should be regarded as serious problem*".

Therefore, the second reason for choosing the inductive approach was to help with the modification of the coding scheme based on it being data driven. The data driven inductive approach can help to improve the existing coding and create a new coding scheme to fit the research purpose. Based on the purpose of the current research the data driven inductive approach can help to define how the different reactions that students have and how they behave relative to the cognitive conflict, can finally help in improving the existing coding scheme (see Chapter 4). The process of analysis involved the identification of categories through "*careful reading and re-reading of the data*" (Rice & Ezzy, 1999) to iteratively modify the coding categories and improve the coding scheme.

3.6.1.1.3 Reliability

Reliability plays an important role in the primary test of objectivity in content analysis and is defined as "*the extent to which different coders, each coding the same content, come to the same coding decisions*" (Rourke et al., 2001). There are 2 methods that have been adopted to test the reliability: intra-rater reliability (1 coder agreeing with herself over time) and inter-rater reliability (2 or more coders agreeing with each other). Most researchers use the inter-rater method to test the reliability of their coding scheme. Rourke et al., (2001) argue that often a cut-off figure of 0.75-0.80 is used and the value of 0.7 can also be considered as reliable. A colleague was asked to help with the coding of the same transcript in order to test reliability.

3.6.1.2 Thematic Analysis

The technique of inductive thematic analysis was applied to construct new themes from data collected from each interview and focus group. The process of analysis followed 6 phases of thematic analysis described by Braun & Clarke (2006). The following different phases are described to illustrate how thematic analysis was used for analysing interview data:

Step 1: Familiarisation with data. The transcript should be read through carefully many times after transcription. This process helps the researcher to generate some initial thoughts and notes about the data.

Step 2: Generating initial codes. After reading the data carefully many times, the original data initial coding was applied.

Step 3: Searching for themes. Themes were generated based on the existing initial codes.
Step 4: Reviewing the themes. This stage involved reviewing the whole process of analysis once the first theme was generated. It helped to check the reliability of the link between the initial codes and the themes constructed. In addition, the relationships among the themes were examined. This process examined the themes. Some of the themes were integrated into new themes and some of the themes were identified as sub-themes.

Steps 5 & 6: defining and naming themes, and write up. These two steps were interwoven with each other. Steps 1-4, help to define themes which were highly contextualised in the data. Therefore, it was also very important to refine the specifics of each theme and to generate clear definitions and names for each theme. Finally, it was necessary to write up the study to present an overall story.

The reason to choose the approach of thematic analysis to for the interview and focus data was because there was no existing coding scheme or model to apply as a guideline. It was an exploratory process used to define the categories and themes which emerged from the data collected from the interview. Therefore, the approach of inductive thematic analysis was suitable to present the overall story from the interview data.

3.6.2 Quantities Analysis

3.6.2.1 Sequential Analysis

The approach of content analysis enables "*a process to systematically examine the quality of learning in online discussion*" (Gunawardena, Lowe, & Anderson, 1997). "Coding and counting" methods (Suthers, 2006) help to reveal cumulative, or relative, frequency distributions of interactions across the categories of the coding scheme. Reimann (2009) agreed that such "*coding and counting*" methods are useful because they provide certain interpretations, which are below the surface of discourse transcripts from data in a given context. However, aggregating counts over time can lose temporal variations of interactional content coded in a particular process category. For example, 2 totally different patterns involving these categories can show the similar proportion of these categories. It means that similar frequency distribution of categories may present contrasting dynamic patterns for those categories. The method content analysis simply focuses on the frequencies of the categories and is not enough to explore the threaded discussions. Many researchers suggest that examining the relationship between messages in threaded discussion is the key to understanding how students interact in CMC (Gunawardena, Lowe, & Anderson, 1997; Newman, Webb, & Cochrane, 1995). Reimann (2009) highlighted that the sequence, or order, of categories coded from the content plays an important role in human learning. The process of human learning does not exist independently, but it is inherently cumulative. In this process the experience accumulated by the information being received will affect how

and what is learned. These interactions in which learners interact with and influence each other in the process of online threaded discussion were important units of analyses for research (Kapur, 2011). Gunawardena, Lowe, & Anderson (1997) built the model to examine the transitions between different phases of critical thinking to illustrate the social construction of knowledge. However, Jeong & Joung (2007) argued that the methodology being applied was still not robust enough and fell short in measuring student interactions and how specific event sequences affect subsequent discussion. The method of sequential analysis can be applied to study student interaction in threaded discussion and how discussion sequence affects subsequent discussion and cognitive outcome. This method has been progressively used in a number of research studies related to online discussions (Dringus & Ellis, 2010; Hou, Chang, & Sung, 2008; Jeong, 2003). The sequential analysis method (Bakeman & Gottman, 1997) selected is appropriate for the current research purpose. Sequential analysis can be used to measure the different reactions that the students have in relation to cognitive conflict and social knowledge construction. For example, how receiving information amongst the discussion group will affect the subsequent discussion and influence how the children learn and what they learn. The dynamic pattern of the reactions helps to compare and contrast the students' quality of interaction in the different learning environments. In addition, the pattern of students' behaviour can also contribute to the improvement of the existing theory of learning.

3.6.2.2 Paired sample t-test

The technique of paired sample t-test was applied to test whether students' answers to questions was affected by the student-led discussion approach. The t-test was of the results of the pre-test and post-tests taken by the students. The paired sample t-test technique focused on the one group of people on two different occasions or under two different conditions (Pallant, 2007). There are two reasons to support the idea that this technique is appropriate in the current study. Firstly, the same group included all participants in this research who attended in two different conditions. Secondly, students were requested to write down their answers to the questions before and after the online student-led discussion study. These were the two conditions under which the data was collected. The results of this technique indicate whether the answers posted by students changed significantly between these two conditions.

3.6.2.3 One way analysis of variance (ANOVA)

The technique of analysis of variance (ANOVA) was applied to find the significance of the reactions that the students performed based on the different year they are in and different previous knowledge or understanding level they have as the independent factor. This technique was regarded as appropriate because it can help to compare the variance between the different groups. For example, students from different years showed different reactions in the student-led discussion. Based on the frequencies of different reactions they performed and different year they were in this technique helped to reveal whether reaction they showed were significantly related or not based on the different years they were in.

3.7 Conclusion

This chapter has presented the methodology and the various methods used in exploring the research questions. The first section presented the design of the research for 3 different phases to answer the questions of this research based on the research purpose. The rest of the chapter explained the development and justification of the various research methods and tools used to collect and analyse the data. The following 4 chapters will outline the process and results of the three phases of the experiment

4 Chapter Four

Peer discussion in Face-to-Face learning environment

4.1 Introduction

The research challenges from the literature review in Chapter 2 Section 2.4, concluded that Chinese students would resist participating in student-led discussions due to the Confucian cultural background that is the bedrock of their education. In order to apply student-led discussions as a new approach for Chinese students to provide them with the opportunity to ask questions and share their viewpoints with others, it is important to explore how Chinese students aged 8-11 engage in student-led face-to-face classroom discussion. One of the main purposes of this chapter is to examine whether Chinese students would voluntarily ask questions and give answers in student-led face-to-face classroom discussions. Additionally, as concluded from the literature review, child-child peer interaction easily leads to incorrect information being spread among students, which would mislead students' understanding during the peer interaction. Although the role of inducing cognitive conflict when students are confronted with conflicting information is regarded as a strategy to increase students' motivation to resolve the conflict, the effectiveness of cognitive conflict as a strategy to help students to achieve conceptual change is still under question. Another purpose of this chapter is to explore how the role of cognitive conflict plays a part in the student-led discussion context that leads Chinese students to challenge the inconsistencies they confront and involve them in a knowledge construction process to avoid spreading incorrect information.

In the following sections, a review will be made of the emergence of research questions based on the research challenges highlighted from the literature review (see Section 2.5). Secondly, there will be an explanation of the main procedure of this study (see Section 4.3), followed by a presentation of the results of this study (see Section 4.4). Finally,

there will be a discussion of the results in relation to the research questions (see Section 4.5).

4.2 Research Questions

RQ1: Do Chinese students aged (8-11) still engage in student-led discussion based on their Confucian hierarchy-based background?

RQ 2: How does cognitive conflict play a role in student-led discussion and lead Chinese students to challenge the inconsistency they confront and thereby enable them to become involved in the knowledge construction process?

This question can be further divided in two sub questions, as follows:

RQ 2.1: What types of reactions occur in a Chinese, student-led, face-to-face discussion?

RQ2.2: Which of these possible types of responses are statistically significantly and reveal significant patterns in the student-led learning environment?

The following section, will introduce how to design the study to achieve the purpose and answer the research questions.

4.3 Research Design

4.3.1 Participants

The participants of this study consisted of 380 students aged from 8 to 11 years old from three different primary schools (referred to in the rest of the Thesis as schools A, B and C) in China. The detailed information about why students from this age range were selected and introductions to the schools and Chinese education system were explained in the Chapter 3 (Section 3.4). They enrolled in a face-to-face class based discussion about a science topic (an explanation as to why the science topic was selected appears in Chapter 3 Section 3.4.3). The science topic was about the growth of plants. The students' knowledge and understanding of the subject of plants varied from student to student. For example, when the Year 3 students took part in this study they had not had any other teaching regarding this subject from their school curriculum. Their teaching on the subject of plant growth was due to start in the Spring Semester. However,

participants from Year 4 to Year 5 had already learnt about the growth of plants from their curriculum.

4.3.2 Instructional task

This study was a class-based student-led discussion, which took place in a classroom environment. Students were assigned to groups of four and took part in a 40-minute session where they engaged in a discussion about the development and growth of plants. The session began with the researcher explaining that the discussion concerned the science topic of plant growth. Each student was provided with a pencil and some paper by the researcher. Next, the researcher asked the students to write down all the information they knew about plant growth on leaf-shaped paper that they then attached to a picture of a plant (see Figure 4.1). Following this, the students were asked to write down at least three questions reflecting their curiosity on the growth of plants. After 10 minutes of discussion, one child representative from each group was asked to ask to pose questions to the students from the other groups. The students who knew the answers were encouraged to stand up to answer the questions. No help with questions or answers was given by the researcher or teacher (who remained silent throughout). Therefore, all questions and answers were considered as being spontaneous.

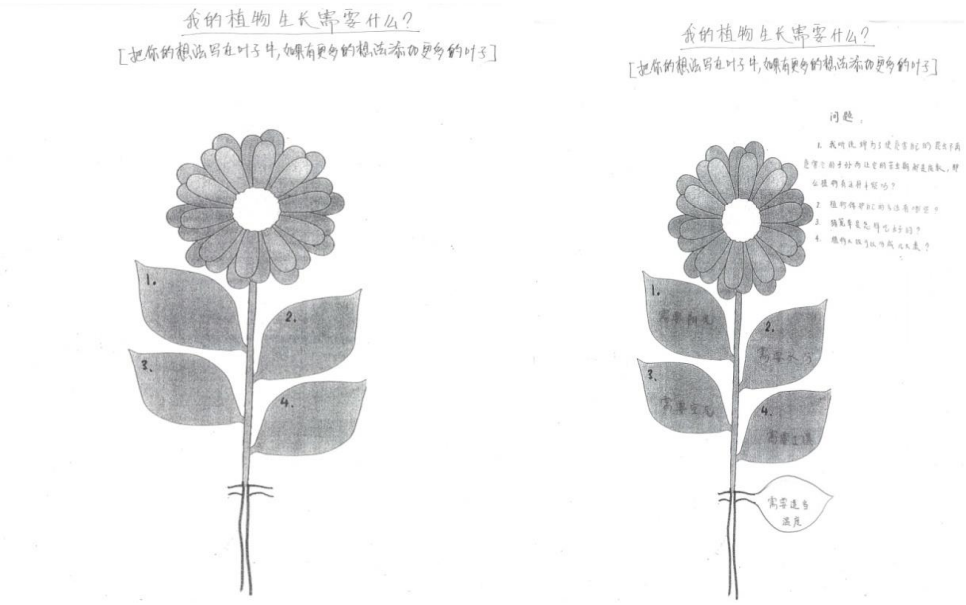


Figure 4.1 Example of material used in experiment

4.3.3 Procedures

Questions and answers were video recorded and transcribed before conducting data analysis. In order to review how Chinese students engaged in the student-led discussion, the focus was placed on the perspective of participation and interaction. For the perspective of participation, the number of students who stood up to show their different standpoints was manually recorded for each session.

In order to examine the perspective of interaction all information that the students showed based on the video recording was transcribed. Next the method of content analysis and sequential analysis was applied to analyse the data. (See Chapter 3 Section 3.6 for a justification of why these two methods were selected for this study.) As explained in Section 3.6.1.1.1, the mixed approach of deductive and inductive analysis was applied in the process of coding. The software program NVivo was applied to code the transcription manually. Eleven categories were identified (see Table 4.1): *Answering (ANS); Alternative Answer (ALA); Extending (EXT)* (extend and complement another's answer); *Agreement (AGR); Disagreement (DIS); Evaluation (EVA)* (judging accuracy, validity, importance of an answer); *Inspiration (INS)* (as shown from others' answers); *Question Complement (QUC)* (adding more information to a question); *Questioning (QUE)* (querying another's answer); *Requesting (REQ)* (asking for more information), and *Summary (SUM)* (reviewing or summarizing points raised). Normally, the first set of answers to a question was coded as *Answering*. Then the following answers were coded based on the children's different reactions to the previous answer. For examples to explain how the coding scheme works see Tables 4.2, 4.3, and 4.4.

The approach of content analysis helps to define the different reactions of students during the discussion. The 'coding and counting' method could help researchers to define the characteristics of the reactions of students below the surface of the transcription and provide an in-depth understanding of the interpretations of why certain behaviours occur during the interactions. However, it cannot show the sequence, or order, of categories in the threaded discussion. The approach of sequential analysis (Bakeman & Gottman, 1997) was applied to analyse consecutive behaviours in the

frequency of each behavioural category immediately following another behavioural category. The formulae used are shown in Figure 4.2 below.

$$m_{GT} = \frac{x_{+T}}{x_{++}} x_{G+} = \frac{x_{G+} x_{+T}}{x_{++}}$$

m_{GT} = *estimate of expected frequency*

x_{G+} = *sum of observed frequencies in the* G^{th} *or given row*

x_{+T} = *sum of observed frequencies in the* T^{th} *or target column*

x_{++} = *total number of tallies in table*

$$z_{GT} = \frac{x_{GT} - m_{GT}}{\sqrt{m_{GT}(1 - P_{G+})(1 - P_{+T})}}$$

$P_{G+} = x_{G+} \div x_{++}$

$P_{+T} = x_{+T} \div x_{++}$

Figure 4.2 Formula used to calculate expected frequencies ((Bakeman & Gottman, 1997)) (left) and formula used to calculate Z scores (right, inset)

Reaction	**Definition of Each Reaction**
Answering *(ANS)*	A first statement used to answer the question.
Alternative Answer *(ALA)*	A statement used to answer the question but irrelevant to the previous answer.
Extending *(EXT)*	A statement used to extend and complement others' answers.
Agreement *(AGR)*	A statement of agreement.
Disagreement *(DIS)*	A statement of disagreement.
Evaluation *(EVA)*	A statement that judges the accuracy, likelihood, validity, logic, relative importance or value of an argument or claim by: 1) making explicit judgment with words like 'good', 'true', 'not likely'; 2) raising alternative viewpoints from which to make judgments.
Inspiration *(INS)*	A statement of getting inspiration from others' answers and shows more information.
Question Complement *(QUC)*	A statement to add more information to the question.
Questioning *(QUE)*	A statement to query others' answers, but not showing status of position.
Requesting *(REQ)*	A statement to request more information to these questions or answers.
Summary *(SUM)*	A statement to review or summarize points risen in discussion.

Table 4.1 Coding Scheme

Reactions	**Example**
Answering	With carbon dioxide and by photosynthesis. It changes into nutrients, which are necessities to plants during growth.
Questioning	Where are they?
Extending	They transform into nutrients.
Alternative answer Agreement Evaluation	I think the water that is absorbed by plants are assigned to leaves (correct!), then if we pick those leaves off and have it placed in the sun, the water inside the leaves will evaporate.
Disagreement Evaluation	I disagree. There is some water remaining in the stem or somewhere else in the plant.
Agreement Evaluation	I think some water will change into nutrients through photosynthesis, and some water is to moisten the flowers, then the extra water is evaporated.

Table 4.2 Example I for coding scheme: (question: where does the water go after being absorbed? (Year 4))

Reactions	**Example**
Requesting	I know the length of grass roots. Is she asking about flower or grass?
Question complement	How long can plants' roots grow?
Answering	The longest root is about 600 kilometres.
Questioning	What? 600 kilometres?
Requesting	Which kind of plant that she is asking?
Extending	All kinds of plants.
Question complement	In general.
Requesting	You should firstly tell us what kinds of plants.
Question complement	I said, generally, how long can most of plants' roots grow?
Summary	Among all the plants' roots, some longer ones can be over 20 centimetres while some shorter ones are only a few centimetres.

Table 4.3 Example II for coding scheme: (question: How long can flowers' roots grow? (Year 3))

Reactions	Example
Answering	The animals that defecate.
Extending	Ants are helpful to plants' growth.
Extending	Bees can help plants to carry pollen.
Extending	Butterflies also could help spread pollen
Summary	Any animal is helpful, the excrement of predators serves as a fertilizer to plants; earthworms are able to cultivate soils and butterflies can spread pollen.
Disagreement Evaluation	I disagree with it. If animals eat plants, that is not good for the plants.
Disagreement Evaluation	I think it is wrong. They still release nutrients after eating plants.

Table 4.4 Example V for coding scheme: (question: which animal is beneficial to the growth of plants? (Year 4))

4.4 Results

4.4.1 Participation

In total, 380 students joined this study and 145 students participated in answering the questions in the discussion. Table 4.5 gives an overview of students' participation in different year groups and at different schools. As documented in that table the average number of the students from each class who participated in this study was 16 (SD=3.95). The participants made between 19 and 57 replies from each class with an average of 45 (SD = 11.7) replies. In the face-to-face discussion environment, some students very actively joined the discussion and showed their ideas to negotiate the meaning with others.

		N	No. Participants	Percentage %	No. Replies	MAXIMUM	MEAN	SD
3		41	8	19.5	19	6	0.46	1.227
4	School A	41	19	46.3	42	6	1.05	1.482
5		39	18	46.2	37	4	0.95	1.213
3		43	13	30.2	47	8	1.09	2.125
4	School B	36	17	47.2	47	7	1.31	1.88
5		38	13	34.2	46	9	1.21	2.338
3		44	20	45.5	54	6	1.23	1.75
4	School C	51	18	35.3	57	12	1.12	2.233
5		47	19	40.4	56	8	1.19	2.007

Table 4.5 Overview of students' participation in different year groups and at different schools

4.4.2 Interaction

A total of 522 questions were proposed. The questions involved many specific plants of which the children were curious, in particular: sunflowers, *mimosa pudica* and *nepenthes mirabilis*. These flowers discussed by students from all of the different age groups. The sunflower and *mimosa pudica* were used to ask exactly the same questions. For example, why does the sunflower face the sun and why does the *mimosa pudica* close their leaves when you touch it? The *nepenthes mirabilis'* questions involved different parts. For example, in what kind of environment do *nepenthes mirabilis* live? What does it look like? Finally, how does the plant eat insects? Students asked many different questions about the plants during this study. Due to the time limitation there were only 182 questions answered during the experiment. There were in total 405 replies that the students provided during the study. Based on the mixed approach of inductive and deductive application, 11 categories were created to represent students' different reactions during the discussion. In order to test whether these different reactions revealed significant patterns in the student-led learning environment the sequential analysis method was applied. In Table 4.6 each column represents the initial behaviour that is labelled by the given code; each row represents the behaviour that follows immediately after a column behaviour has occurred and this is called the target code. The numbers in the table represent the total frequency of when a behaviour appearing in the row follows immediately after a behaviour that appears in a column (for example, the number 35 in row 1, column 3 means that 'EXT (extending) occurs immediately after an ANS (answer)' 35 times).

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	QUC
ANS	0	56	35	7	4	3	0	9	18	8	1
ALA	0	25	13	3	2	4	2	6	5	7	0
EXT	0	6	17	2	1	2	2	5	2	4	1
QUE	1	2	1	0	4	1	0	3	0	3	0
REQ	0	4	4	0	1	0	0	0	0	2	4
INS	0	2	3	1	0	2	0	1	2	3	0
SUM	0	0	1	0	0	1	0	1	0	0	0
DIS	0	1	0	0	0	2	0	0	0	33	0
AGR	0	10	1	0	0	0	0	1	2	14	1
EVA	0	8	7	3	0	5	1	11	8	6	1
QUC	3	2	0	0	1	1	0	1	0	1	0

Table 4.6 Observed Frequency Transition Table

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	QUC
ANS	1	39	27	5	4	7	2	13	12	27	3
ALA	1	18	13	3	2	3	1	6	6	13	1
EXT	0	12	8	2	1	2	0	4	4	8	1
QUE	0	4	3	1	0	1	0	1	1	3	0
REQ	0	4	3	1	0	1	0	1	1	3	0
INS	0	4	3	1	0	1	0	1	1	3	0
SUM	0	1	1	0	0	0	0	0	0	1	0
DIS	0	10	7	1	1	2	0	3	3	7	1
AGR	0	8	6	1	1	1	0	3	3	6	1
EVA	0	14	10	2	2	2	1	5	4	10	1
QUC	0	2	2	0	0	0	0	1	1	2	0

Table 4.7 Expected Frequencies for Responses

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	QUC
ANS	-1.4	**4.0**	**2.0**	0.9	-0.2	-1.9	-1.6	-1.3	**2.0**	-7.1	-1.3
ALA	-0.9	**1.9**	0.0	0.3	-0.1	0.4	1.5	0.0	-0.4	-4.6	-1.2
EXT	-0.7	-2.0	**3.6**	0.3	-0.3	-0.1	**2.3**	0.7	-1.0	-5.1	0.2
QUE	**2.3**	-1.3	-1.3	-0.8	**5.4**	0.3	-0.4	1.5	-1.2	0.4	-0.5
REQ	-0.4	-0.1	0.7	-0.8	0.8	-0.9	-0.4	-1.2	-1.2	-3.1	**7.2**
INS	-0.4	-1.1	0.2	0.7	-0.7	1.6	-0.4	-0.3	0.7	1.1	-0.5
SUM	-0.2	-1.1	0.6	-0.3	-0.3	**2.3**	-0.2	1.5	-0.5	-10.0	-0.2
DIS	-0.6	-3.5	-3.1	-1.2	-1.1	0.2	-0.7	-2.0	-1.9	**37.7**	-0.9
AGR	-0.5	0.9	-2.3	-1.1	-1.0	-1.3	-0.6	-1.1	-0.4	**15.1**	0.6
EVA	-0.7	-1.9	-1.0	0.9	-1.3	**1.7**	0.6	**3.4**	**1.9**	-3.8	0.1
QUC	**10.1**	-0.4	-1.5	-0.6	1.4	0.9	-0.3	0.2	-0.9	-4.2	-0.4

Table 4.8 Z-scores for tests of significance (When the z-value of a sequence was larger than +1.65, it means that the degree of continuity reached statistical significance ($p < .1$))

In order to find the significant patterns of different reactions, the formula discussed in Figure 4.2 was first applied to the expected frequencies (see Table 4.7). Then, based on the formula in Figure 4.2, the z scores were calculated with significant values ($p<.1$) of each sequence highlighted in red (see Table 4.8). From these data a deduced behaviour transfer diagram was produced and is shown in Figure 4.3 below. This illustrates diagrammatically the weightings of the target codes which follow given codes.

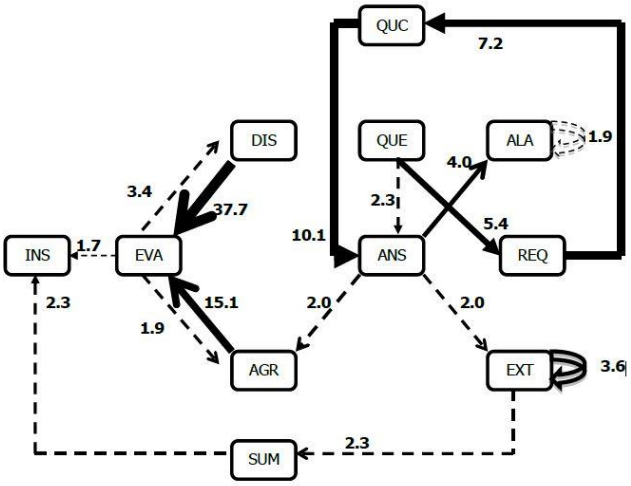


Figure 4.3 Response behaviour transfer from children when they answer the questions in the Face-to-Face student-led discussion.

This significant pattern of interaction showed that students actively presented their different standpoints and interacted with other students. As can be seen from Table 4.8 and Figure 4.3 there is a strong link between the reactions of *Questioning*, *Requesting* and *Question Complement*, which then leads to *Answer*, demonstrating a clear path through which children evaluate the questions that others ask by asking for further information. An *Answer* then leads to three significant reactions: *Alternative Answer*, *Extending* and *Agreement*, with the largest weight being *Alternative Answer* with a weighting of 4.0. *Alternative Answer*, however, only leads to itself. This shows that the children did not have significant reactions followed by the reaction of *Alternative Answer*. The following examples are provided to illustrate the significant pattern that reveals that students ask for more information to make questions better (see Table 4.9).

Reactions	**Example**
Questioning	I think her question "whether" needs to be re-written with "in general".
Requesting	I know the length of grass roots. Is she asking about flower or grass?
Question complement	How long can plants' roots grow?
Answering	The longest root is about 600 kilometres.
Questioning	What? 600 kilometres?
Requesting	Which kind of plant that she is asking about?
Extending	All kinds of plants.
Question complement	In general.
Requesting	You should firstly tell us what kinds of plants.
Question complement	I said, generally, how long can most plants' roots grow?
Summary	Among all the plants' roots, some longer ones can be over 20 centimetres while some shorter ones are only a few centimetres.

Table 4.9 Example: (question: How long can flowers' roots grow? (Year 3))

The occurrence of *Agreement* following Answer has a weight of 2.0. This shows evidence of pupils presenting their position to support other pupils' ideas, as would occur in a no conflict situations. In conflict situations, responses of *Alternative Answer* and *Extending* were observed, although *Extending* also occurred in no conflict situations. No significance was found between *Answer* and *Disagreement* and these both lead to *Evaluation*. These results are similar to outcome of Jeong's (Jeong, 2003) research.

Extending leads to itself but also leads to *Summary*. It seems that *Extending* reactions encountered by the children help to induce reactions of *Summary* showing that this further information aids the formation or reinforcement of knowledge. Reactions of *Disagreement*, *Agreement* and *Evaluation* show that children are able to present their own viewpoints to others, whether different or the same and, consequently, information is assimilated (Piaget, 1955), strengthening their knowledge. *Inspiration* has no significant lead to other responses but it does have two significant connections from *Evaluation* and *Summary*, as would be expected.

4.5 Discussion

This chapter has investigated how Chinese students are involved in face-to-face student-led discussions. Sections 4.5.1 – 4.5.2 discuss the findings in responses to the two research questions.

4.5.1 Chinese Students Participate in Discussion

This section responds to the research question (Q1) higlighted in section 4.2, which is: *Do Chinese students aged (8-11) still engage in student-led discussion based on their Confucian hierarchy-based background?*

The results of the data transcribed from the video recording shows that the Chinese students participated and interacted with each other in the face-to-face learning environment. From the perspective of question design a total of 522 questions were designed, which covered many specific plants such as *sunflowers, mimosa pudica and nepenthes mirabilis*. In the question design process, initially, it was observed that some students mentioned that they did not know what kind of questions they can design and also they were concerned that the questions they designed might be laughed at by other students or that their questions would be too simple or not. After the researcher highlighted that they can ask any questions they like and no one will laugh at their questions the students were observed trying to think of as many answers as they could within the allotted time. From the perspective of answers provided by students, 38 percent of students stood up to answer the questions. It can be regarded as a good response from Chinese students compared with traditional classroom discussion based on the feedback of Chinese teachers' after this study. In addition, the number of students who joined in the discussion is the actual number of students who stood up to present their ideas. There were many other students who tried to show their ideas during the study but time was limited and therefore they could not present their ideas.

Based on these two findings on the perspective of question design and answers provided by students, there is a strong contrast with existing literature which highlighted that a new approach that required students to actively join in the discussion would encounter resistance from Chinese students (Li, Rao, & Tse, 2012; Nguyen, Terlouw, & Pilot, 2006). Also, the Confucian cultural background was regarded as the main factor to

explain the reason that Chinese students would not present their own ideas to avoid conflict in front of others. However, it is not appropriate to use the Confucian cultural background to explain that Chinese students' resistance to joining in the discussion. There are three reasons explained to support it.

Firstly, although the rate of Chinese students' participating in this study cannot show whether they actively participated compared to existing studies, the good responses were supported by the Chinese teachers, which implies that not all Chinese students resisted this student-led discussion approach which required the students to actively join in the discussion.

Secondly, at the beginning Chinese students showed a certain degree of concern on designing questions due to the factor of their Confucian cultural background. However, with encouragement from the researcher they became very willing to design various questions.

Thirdly, based on various reactions and significant patterns that Chinese students revealed from student-led discussions (such as disagreement → evaluation and evaluation → discussion), it also implies that Chinese students will present different viewpoints when they are confronted with conflicting information, which also contrasts with existing literature (Chan, 2008; Chiu, 2009; Shi, 2006) that argues that Chinese students would not present their own ideas in order to avoid conflict.

In summary, Chinese students will voluntarily ask questions and give answers in student-led face-to-face classroom discussions, but there is still the possibility to encourage more students to join in classroom discussions. Additionally, whilst the Confucian culture does have an effect on Chinese students' behaviour, it does not mean that all Chinese students resist participating in student-led discussions.

4.5.2 Reactions implies cognitive conflict and knowledge construction process

This section responds to the second research question (Q2): *How does cognitive conflict play a role in student-led discussion and lead Chinese students to challenge the*

inconsistency they confront and thereby enable them to become involved in the knowledge construction process?

As the research results concluded from the literature review shows, incorrect answers posted in the student-led discussion would mislead students understanding. However, existing research suggests that the construction of knowledge, which was regarded as one mechanism of collaborative learning, would help to students to critically engage constructively with one another's ideas (Mercer, 1996). Research also shows that cognitive conflict induced by cognitive dissonance when students are confronted by conflicting information would help to increase student's motivation to solve the conflict, which also can help towards the spreading of any incorrect information. In order to evaluate whether cognitive conflict and knowledge construction could help to make progress towards better knowledge a review was needed of whether the significant patterns of reactions revealed by the results of the qualitative and quantitative data analysis involved the role of cognitive conflict and knowledge construction in the student-led discussion.

There are 11 different reactions defined by the results of discourse coding (see Table 4.1): Answering (ANS); Alternative Answer (ALA); Extending (EXT) (extend and complement another's answer); Agreement (AGR); Disagreement (DIS); Evaluation (EVA); Inspiration (INS); Question Complement (QUC); Questioning (QUE), and Summary (SUM). Each different reaction displayed by the students revealed their different positions in the student-led discussion. Significant patterns were also revealed in the results (see Section 4.4.2). In order to review whether reactions and significant patterns revealed by the results involved cognitive conflict and knowledge construction processes, the existing frameworks proposed by Pena-Shaff and Nicholls (2004), Gunawardena, Lowe, and Anderson (1997) and Veerman & Veldhuis-Diermanse (2001) were used for reference,. All of these focused on evaluating how older students interact in collaborative learning based on the knowledge construction perspective. However, there is very little empirical study that has been conducted with students from primary schools, which leads to the question of how these reactions revealed from this study could lead to an improved model of framework for children's reaction analysis based on the existing interaction analysis model (Gunawardena, Lowe, & Anderson, 1997; Pena-Shaff & Nicholls, 2004; Veerman & Veldhuis-Diermanse, 2001).

The following sub-sections will introduce the improved model of the yonger child interactive reaction analysis which focuses on how the existing reactions defined by this study can reveal the different phases of the knowledge construction process for younger students compared with the existing model by Gunawardena et al., 1997 (see Section 4.5.2.1). This model can shed light on exactly how Chinese students perform during student-led discussions. Secondly, a discussion is made of how the role of cognitive conflict plays a role in the student-led discussion based on the child's interactive reaction analysis model (see Section 4.5.2.2).

4.5.2.1 Improved model of the children interaction analysis

Based on the reactions and significant patterns of these reactions defined by the results, an improved model of the children's interaction analysis including five phases was designed to illustrate the different phases that children were involved in during the student-led discussion (see Figure 4.4). Phase I of the model is the statement that students posted to show and share their own viewpoints, which is also the first step for them participating in the discussion. This is similar to the first phase of Gunawardena et al. (1997)'s model, which is more focused on comparing others' statements and sharing one's own statement on agreement perspective.

In the second phase, Gunawardena et al. (1997) focused on the dissonance which is similar to Piaget's (1954) theory about cognitive conflict. He only focused on the discovery and exploration of dissonance or inconsistency among ideas in the second phase. In contrast to Gunawardena et al., (1997)'s model, the second phase of this model illustrates the different behavioural reactions of students that were classified into conflict and non-conflict sections. As reviewed from the literature (Section 2.3.4.2 in Chapter 2), most researchers classified reactions as being whether they confronted with conflict or not based on their previous experience (Chan, Burtis, & Bereiter, 1997; Chinn & Brewer, 1993; Piaget, 1954). As explained by Piaget (1953), if students have little or no previous experience, it is difficult for them to detect whether they had conflict or not, which is not highlighted in the model (see Figure 4.4). On the other hand, if students have enough previous experience, based on this experience, the reactions they performed from the results can be classified as conflicting behaviour and non-

conflicting behaviour. For example, the reaction of *Agreement* was classified into no conflict, and the reactions of *Questioning*, *Requesting*, *Disagreement, and Alternative Answer* were classified into the conflict part. The reaction of extending involved both conflict and no conflict.

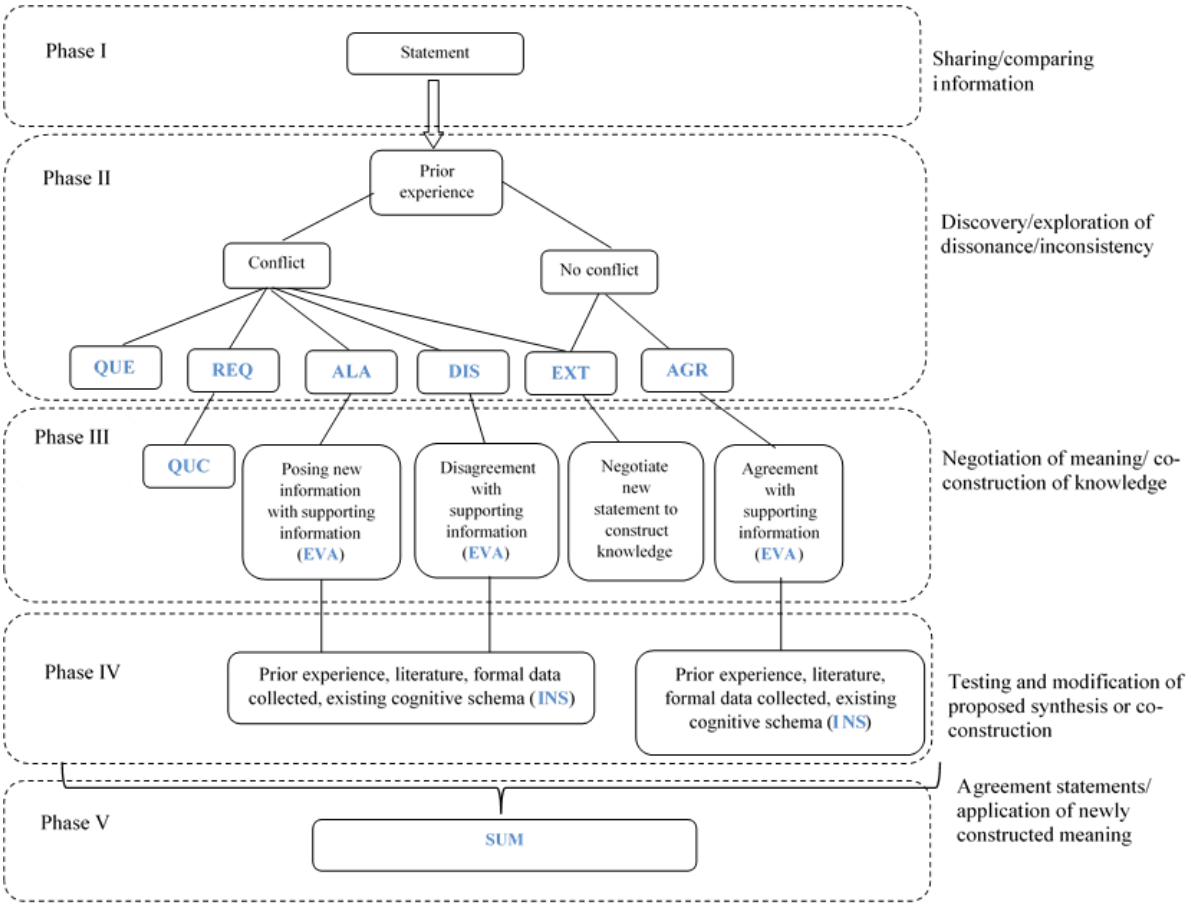


Figure 4.4 Model representing response patterns in the Chinese classroom (Phases corresponding to Gunawardena et al. ((Gunawardena et al., 2009)) models are shown on the right)

In the third phase, the categories align with the mechanisms used by the participants to negotiate meaning and construct knowledge. The reactions under the conflict or non-conflict section and evaluation, represent the participation involved in the process of negotiation of meaning. In this phase, it is reciprocal interaction, which students negotiate (alternative answer, extending), clarify and justify any ideas they do not understand (questioning, requiring, question complement), defend their own ideas (disagreement, evaluation) and agree with any ideas (agreement, evaluation). The instrument of Veerman et al. (2001) also supported applying the category of Evaluation in the negotiation phase.

In the fourth phase, the reaction of inspiration was applied to build connections or reflections into their personal experiences. The definition of inspiration is the statement of getting inspiration from others' answers and reflecting on their own experiences. In contrast to Gunawardena's model, it used the term of testing and modification of proposed synthesis or co-construction to describe the fourth phase, which mainly focused on how inconsistent information received from others against their existing experience such as existing cognitive schema, personal experience, formal data collected from experience or information read from literature. This child interactive interaction analysis model proposed here used the term 'inspiration' to elaborate the behaviour of the children which mainly focuses on reflection and connection induced between the information they received from others and existing experience they had; such as personal experiences, knowledge taught by teachers in the classroom or information they read from literature no matter whether they agree or disagree with the information they received during the discussion.

The fifth phase, involves the *Summary* of all of the different perspectives gained from the others.

This model is developed based on how the Chinese students reacted and how these reactions interact with each other. The 5 phases presented in this model show different levels of knowledge construction that students experience during the student-led discussion. Based on the characteristics of this model, the role of cognitive conflict can be highlighted in Phase two and three. A discussion of how socio-cognitive conflict effects the reactions that students have in the student-led discussion, which contrasts with the reactions discussed in the literature review appears in the next section. The role of how cognitive conflict influences the knowledge construction process is also discussed.

4.5.2.1.1 The role of socio-cognitive conflict in student-led discussions

As shown in Phase II and III of the model shown in Figure 4.4, the role of socio-cognitive conflict is important in the student-led discussion and knowledge construction process, which may promote different reactions during student interaction and would make students become involved in a higher phase of knowledge construction. As

mentioned before in Chapter 2, the existing literature explains that the role of cognitive conflict leads to different reactions performed by students, which can be the strategy to help students to achieve conceptual change (Asterhan & Schwarz, 2009; Limón, 2001; Mason, 2001). However, many researchers (Dekkers & Thijs, 1998; Strike & Posner, 1992) argue that the strategy they adopted by presenting only baffling information to students may not be effective. Some researchers (Chan, Burtis, & Bereiter, 1997; Mason, 2001) suggest that the collaborative learning context may be considered as the idea source for promoting and resolving conflict. The different reactions defined when students interact with other students in the collaborative learning context (student-led face-to-face discussion learning environment) leads to a need to compare and contrast the role cognitive conflict played in the choice to passively accept or not the conflicting information learning context and the dynamic interaction learning context.

In contrast to asking students to passively accept or not the conflicting information they confront, the collaborative learning context focuses more on the dynamic interaction among students. The pattern of different reactions' defined by this study in the Chinese classroom (see left side of Figure 4.4) explain the different reactions that children will have in the process of dynamic interaction. A major concern that many researchers highlighted and which places cognitive conflict in doubt as a strategy is because students may reject, ignore, exclude or put aside the conflicting information when they present confusing information to students as a strategy for achieving conceptual change. These reactions are the conclusion of Piaget (1954) and Chinn and Brewer (1993)'s research. In the collaborative context, the different reactions defined in the children's reaction analysis model explains that although students may reject and exclude the conflicting information received from other students, they still can actively promote knowledge building by showing different reactions by negotiating with the meaning. For example, if students experience the ignore, reject and exclude reactions in the responses that Chin and Brewer proposed (Chinn & Brewer, 1993), they can still post their own ideas through different reactions of requesting, questioning and *disagreement*. This helps the children to present their ideas and get feedback from others even when they have rejected and excluded their ideas. In contrast to the models proposed by C. a. Chinn & Brewer, (1993) and Piaget, J., & Cook, (1952), reactions defined from this study focus on how children can actively and iteratively review their own, and others', ideas. This interactive behaviour proves that knowledge is not static and closed where

there is always a true and correct answer. Knowledge should be dynamic and build constructively by different students. The process of knowledge construction also is not simply built by correct answers, in contrast, it is a shared representation achieved by different forms of reactions performed by students that may include correct or incorrect information.

The different reactions that children demonstrate especially with their behaviour in cognitive conflict, results in the promotion of dynamic exchanges and changes occur whereby new discoveries and new explanations of knowledge emerge (Limón & Carretero, 1997). It is the first step to deeper learning when children start to compare their own ideas with others. Then gradually children will become involved in the process of knowledge building through *Argumentation* and *Evaluation* reactions. Limon (1997) points out that giving children conflicting information does not mean that children can change their understanding in their schema automatically. Conflicting information can induce confusion and conflict in children, and it cannot simply make children statically receive the conflict or memorise specific information. The key core of the strategy of learning is to allow children to undertake a more active role and, as a participant, to negotiate and evaluate the knowledge they understand and challenge their misunderstanding. In the student-led discussion the role of cognitive conflict can promote the student as an active participant to interact with other students to negotiate meaning and this aids knowledge construction.

In summary, in the student-led discussion process discourse revealed information with different viewpoints which may be correct or incorrect information. These different viewpoints, when shared, led to different reactions that students performed in the discussion process. The different reactions and significant patterns as defined in this study show that students justify their individual viewpoints to negotiate with others to finally achieve shared knowledge construction. The role of cognitive conflict played in this knowledge construction process is to encourage students to dynamically exchange their different viewpoints to negotiate and evaluate the knowledge they understand and challenge it. The pattern showed from this study based on different reactions supported van Aalst and Truong (2011)‘s claim. He highlights that the main purpose of discourse and collaborative learning is not to find the ‘correct answer’. It is a process to make a progress toward better understanding of the knowledge. The word ‘better’ can mean the

better knowledge awareness or better evidence to support your viewpoint. But this also can be the better understanding of the limitations of your knowledge. One research challenge is the concern that incorrect information would mislead students. However, the findings of this study show that different reactions and the significant patterns defined reveal a process in which the students approach a better understanding of their knowledge. In the collaborative learning environment, the main purpose is not to avoid the incorrect spreading of information, in contrast, it should encourage students to show their various viewpoints when they confront conflicting information, and promote themselves as active participants by negotiating and evaluating with one another to achieve better understanding of the subject.

Although the model proposed is used to illustrate the process of knowledge construction for students to gain better understanding of their subject and to avoid misleading by providing incorrect information, the significant patterns revealed still have certain limitations in this study. In the following section the limitations of significant patterns will be discussed and factors that would lead to this limitation will be illustrated.

4.6 Limitation

Whilst having discovered and highlighted various processes to help with children's cognitive processing in knowledge attainment, this research has also discovered limitations to do with children's patterns of behaviour during the discussion. As the results demonstrate, answers lead to *Alternative Answers*, *Agreements* and *Extending*, but they do not lead to *Disagreement*. In addition, *Alternative Answer* and *Extending* did not lead to other reactions except themselves. There are 3 possible threads, based on what was observed, which would generate such results, and these are shown in Figure 4.5.

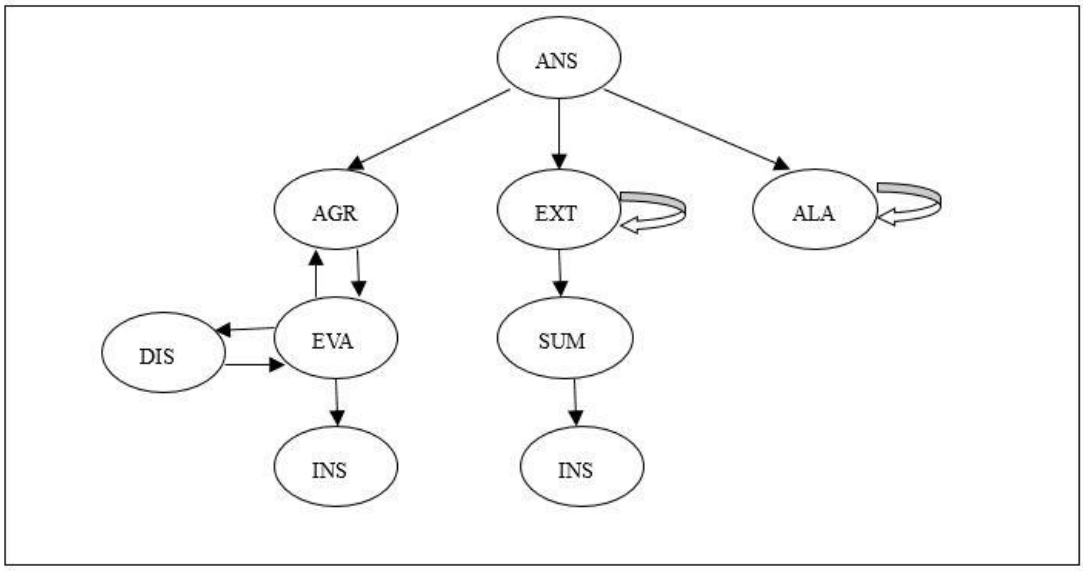


Figure 4.5 Different possibilities of thread revealed from significant pattern of reactions

In Figure 4.5, it can be seen that following an *Answer* there were 3 possible reactions. If the reaction was *Agreement*, it would involve strong argument and *Evaluation* of the idea, but without any new standpoint being proposed. If the reaction was *Extending* it leads to *Summary* and *Inspiration*. Alternatively, *Answer* followed by *Alternative Answer* will only lead to itself without involving any other reaction. There is no following reaction followed by reaction of alternative answer, which may make students find difficulty in judging whether this information posted by students is incorrect. As discussed before, the main point of collaborative learning should not focus on whether they present correct or incorrect answers, in contrast, it should encourage students to present their own different points of view, which helps them to form the reciprocal process to generate explanation, justification and reflection. However, there are no further reactions followed by the reaction of alternative answer, which limits the reciprocal process to evaluate different viewpoints. In the following sub sections, the potential factors causing this limitation will be discussed.

4.6.1 Homogeneity of the group:

In a face-to-face learning environment, even when children are from the same class and have a similar knowledge background, there will be some pupils who have a greater understanding of the material than others. This is what was observed in the experiment and is one reason for the existence of *Extending* and *Alternative Answer* responses. This

reveals the important role of more knowledgeable children in peer interaction and enables pupils to explore each other's reasoning and viewpoints in order to construct a shared understanding of the task. However, the homogeneity of the group will limit people exhibiting a greater depth of knowledge when students are from the same school and same class. There is an example from this study that illustrates this situation.

"Is there any plant in this world growing on animals' bodies?"

"Mosses grow on tortoise."

"There is a plant called Pandora they grow on a creature living in stone crevices. "

There were only two students who answered the question because the students could not evaluate the answer due to the limitations of their existing knowledge. It also connects to the unadapted responses from the model that Piaget pointed to before. None, and/or little prior experience would limit students' ability to evaluate this information. Based on this situation, it reveals the important role of the more knowledgeable children becoming involved in peer interaction. However, simply because one child may be more knowledgeable than another does not mean that this would impede any relationship that child has with another, be it adult – child, such as teacher – child and parent – child. The adult—child relationship is one of unilateral authority, which is regarded as the asymmetrical nature of the adult-child relationship. In this relationship children would always respect the views of authority without a complete understanding of those ideas. Consequently it reduces the opportunity of reasoned dialogue because of that relationship. Compared to the defence of their own ideas, or negotiating the meaning with others in the symmetrical relationship; this relationship makes children accept what they are told in a one-sided discussion. It also reduces the rate of interaction between children in the classroom. Therefore, to encourage individual thought, understanding and knowledge there does not only need to be an avoidance of the asymmetrical relationship, but there also needs to be an increase in the reciprocal process of exploring each other's reasoning and viewpoints by asking the more knowledgeable children involved in the discussion to share their information.

4.6.2 Limited time

This experiment was a classroom-based discussion. The time for each experiment was forty minutes. There were around 40 children in each classroom. In addition, in the face-to-face environment, the discussion cannot proceed in parallel discussion threads. This

production blocking would prevent the children from actively participating in the discussion. It is common in production blocking that these situations unroll because of the need to take turns in the face-to-face setting. Due to the limited time and turn taking there is less of an opportunity for all of the children to participate in the discussion and to develop their own ideas.

To promote engaged discussion between peers in a Confucian culture, and therefore to promote reviewing of different viewpoints in order to avoid incorrect information from spreading, technology as an intervention has proposed to promote augmenting the Chinese classroom and hence the model. Figure 4.6 shows the proposed new model illustrating in blue where technology could compensate for the restrictions felt by children in their Confucian culture thus prompting more cognitive conflict and hence discussion. The next experiment was designed to investigate where technology could help to overcome the limitations listed above and promote the sequences that were lacking. It was expected to improve the discussions' depth. As shown in Figure 4.6, the black, solid arrows represent the children's significant pattern of reactions in this research without any intervention, and the blue, solid arrows represent the enhanced sequences that technology could improve in the discussion.

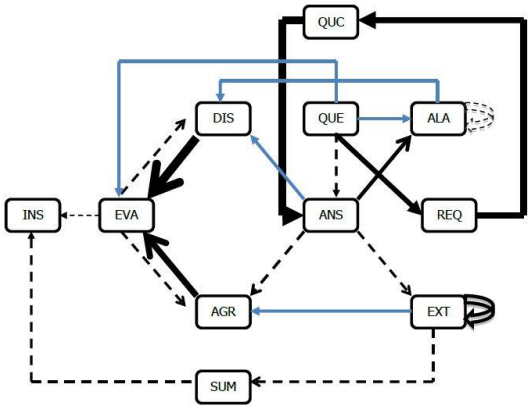


Figure 4.6 Proposed technological intervention to improve Chinese children's interaction patterns

4.7 Conclusion

The findings of this study show that Chinese students will voluntarily ask questions and give answers in student-led face-to-face classroom discussions. Although the Confucian cultural background of Chinese students was seen to be a factor that could affect them when the questions were designed and when answering the questions, it did not prevent the Chinese students from participating in the student-led discussion. The number of questions designed and different reactions they performed implied that Chinese students can still accept this approach which requires them to actively participate in the discussion.

Additionally, the different reactions and significant patterns defined by this study also shed light on a new improved model of Chinese students' interactive reactions analysis. It helped to illustrate the different phases that students are involved in during the knowledge construction process. The role of cognitive conflict was also defined based on the reactions revealed in Phase II and III of the study. The pattern of reactions involved cognitive conflict, which implies that students negotiate with others by using different reactions (such as questioning, requesting, disagreement, alternative answer) to achieve a greater understanding of the subject. The findings of this study suggest that there should be less concern regarding the spreading of incorrect information. However, it should promote students to dynamically exchange different viewpoints when they confront conflicting information, which helps to lead to more interactive discussions to review each point of view. Then finally, it leads towards a shared knowledge construction. However significant the patterns that were revealed are they still show certain limitations in the quality of interaction.

As concluded from this study, Confucian culture may be overstressed as a factor to explain Chinese students' behaviour in regards to avoiding presenting their own viewpoints in the classroom and Chinese students' attitudes regarding resisting new approaches to their learning. Different methodologies and classroom interactions were taken into consideration in the following studies. Technology was proposed as an intervention to support student-led discussions for students to improve significant patterns of interaction. In the following chapter, an explanation of how the technology was designed based on the results of this first study will be present

5 Chapter Five System Design

5.1 Introduction

Chapter 4 evaluated how Chinese elementary school students could engage in a student-led discussion in the face-to-face learning environment. Student-led discussion is considered to be a new approach for Chinese students enabling them to ask questions and answer questions to share their different standpoints. Chapter 4 also highlighted the limitations of this approach in the face-to-face learning environment. As a result of the literature review in Chapter 2 it was believed that a technology supported student-led discussion could work for Chinese students. This chapter aims to explain how the theoretical framework was used to design and implement an online system.

5.2 System design

The system needed to be designed not only to help Chinese primary school students to learn actively, but also to overcome limitations highlighted in the study conducted in Chapter 4. As discussed in Chapter 2 Section 2.4.2, there are many existing technologies, such as blogs, wikis and forums (Q&A), and many researchers use some of these to support students' collaborative learning. User generated content is critical to these tools to enable sharing, interaction, and peer review. However, some researchers (Fu, Chu, & Kang, 2013; Hou, 2009) pointed out that such tools are often complicated to use which would reduce students' motivation to use them. This is made worse by the fact that Chinese primary school students do not have much experience with online learning systems. Adopting existing social network sites was also not appropriate for this study as inappropriate content could worry parents as a result of potential abuse of children and associated E-safety issues. Therefore, three key principles of the system design were formulated. The system must be:

1) Simple to use
2) Inclusive of the key characteristics of existing technology and
3) A safe learning environment.

Based on peer interaction theoretical framework discussed in Chapter 2, three key components were specially identified for Chinese students to engage in active learning:

1) Question & answer

2) Contribution

3) Peer review.

It is worth mentioning that the Confucian culture is regarded as the most important factor affecting Chinese students' ability to show their own standpoints during peer interaction. As a result the system had to add anonymity as an important feature.

5.3 System framework

The key characterises of this system were based on the theoretical framework of peer interaction (see Chapter 2 Section 2.3) and a summary of existing technology tools designed to support students' interaction was given in Chapter 2 Section 2.4.2. This section will illustrate the basic framework of this system and present the interface which was implemented to meet all requirements stated above. There are two main parts in this system, one is the student-led discussion learning system and the other one is the teacher management system for teachers (see Figure 5.1). The interface of Login permission was designed to create a secure learning platform for students to share their knowledge (see Figure 5.2). As discussed in the literature review (section 2.4.3.2 in chapter 2) abuse of children by adults through the internet would affect students' E-safety issues. This system presents different user accounts for students to use. In this situation other people will be prevented from using this learning platform.

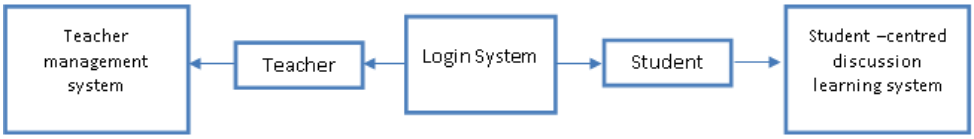


Figure 5.1 framework of an online student –led discussion learning system

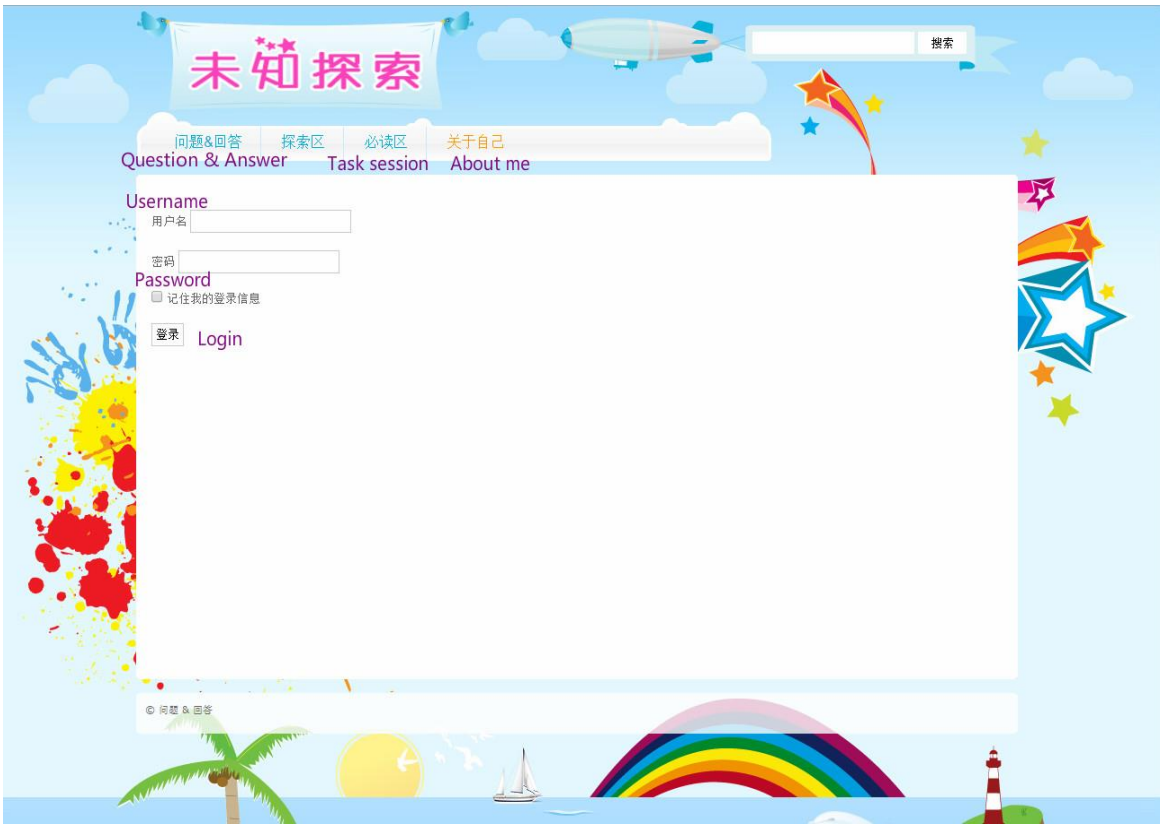


Figure 5.2 The Interface of student –led online discussion system's login page

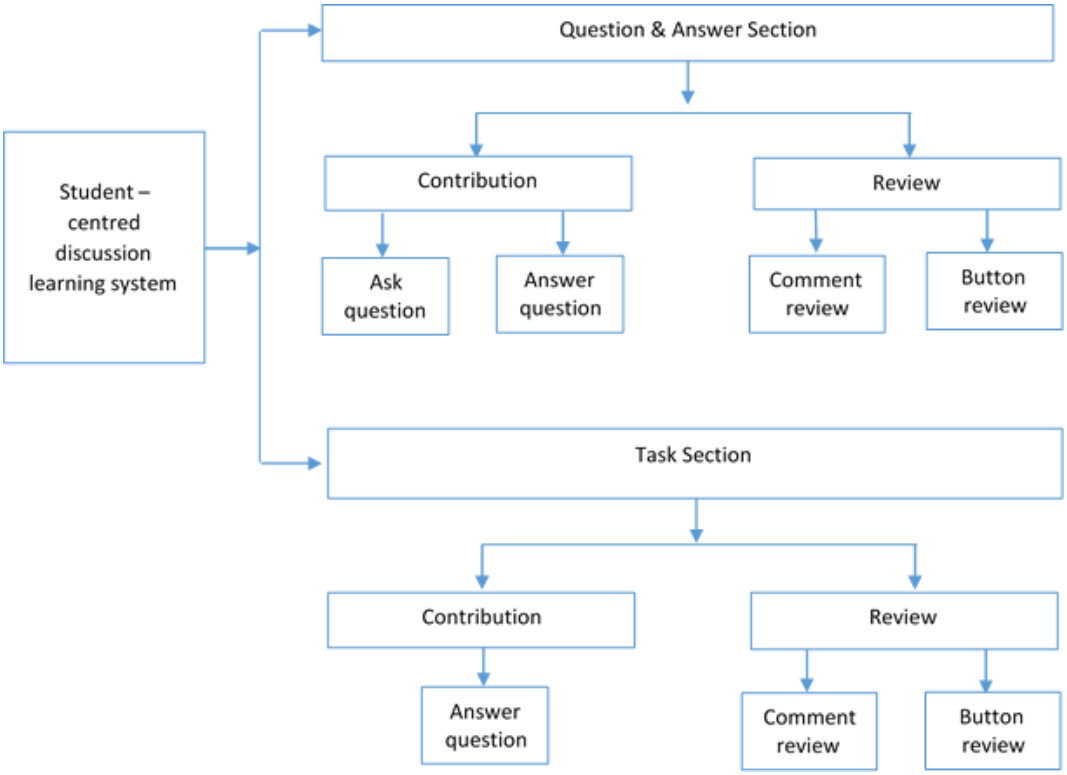


Figure 5.3 student –led discussion learning system‘s framework for student

5.3.1 Student – led discussion learning system

The main functions designed were to provide opportunity for students to ask questions and discuss with others students. There were two main sections that students accessed in this system (see Figure 5.3). One was the Question & Answer section which was the number one aim of the design. The second was the Task Section – further discussed below. In the Question and Answer Section, as the name suggests, students could make contributions to the peer interaction by asking and answering questions. Figure 5.4 shows all the functions provided by the Question & Answer section. Firstly, the interface of questions listed all the questions that had been created by the students. Students could interact with each question. In addition, if students were interested in a question they could also add it to their favourite questions list. Secondly, the question view page presented the question information and followed this with comments (see Figure 5.5). Students had two ways to review other students' comments. The first was to post comments to present their own standpoint to negotiate with others. The second was to use one of three interface buttons "agree", "disagree" and "confused" to quickly respond. The reason for these three buttons was based on the results of the significant patterns revealed from the face-face student-led discussion discussed in Chapter 4 Section 4.4.2. This showed that the possibility of evaluation reaction followed by the reactions of agreement and disagreement were higher than other responses. Thirdly, the interface contained a "comments post page" to allow students to show their own comments to answer the questions (see Figure 5.7). In addition, based on other students' reviews, if a student had a different answer or opinion she/he could reply to different questions and comments by using audio and images. Finally, the interface of "question-post" provided the opportunity for students to ask various questions if they had any enquires (see Figure 5.6). In this students could also use various media to create questions such as images and audio.



Figure 5.4 Interface of student-led online discussion system's Question & Answer's page

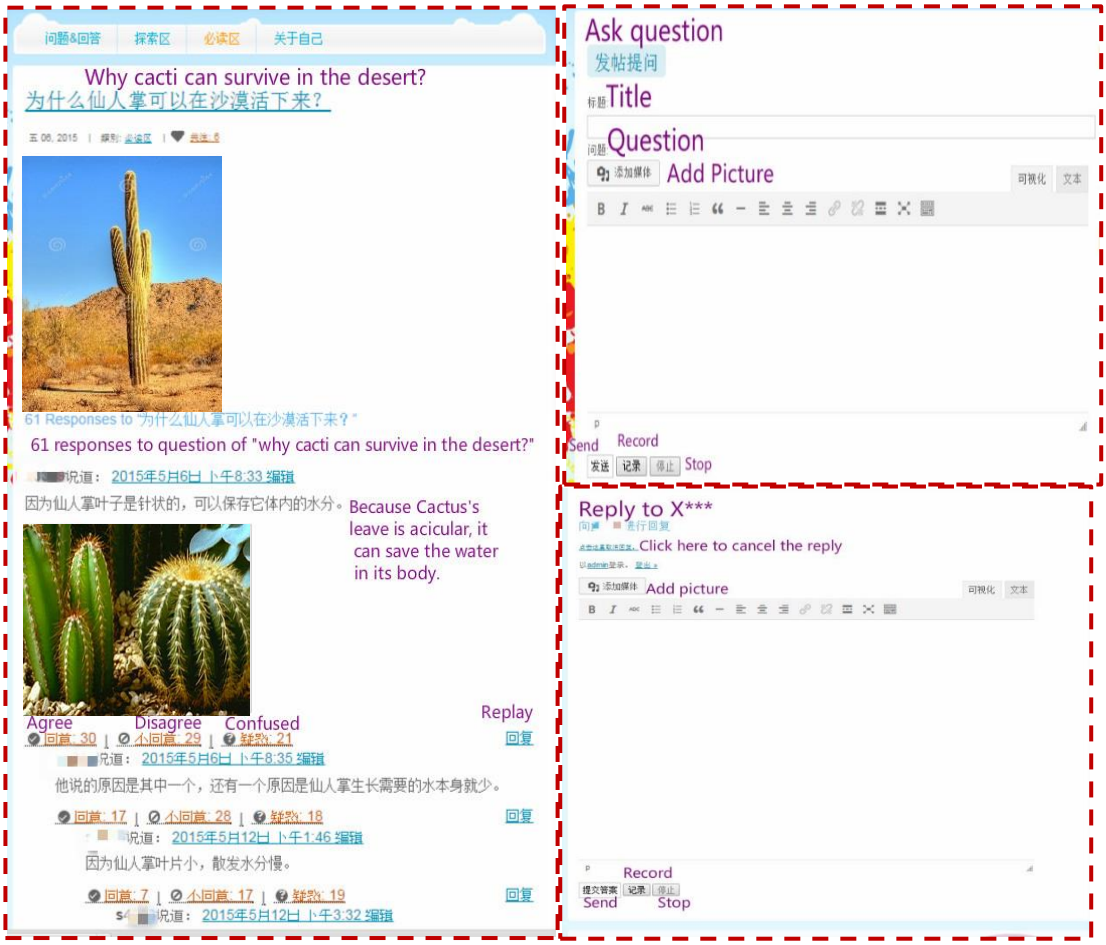


Figure 5.5 The interface of student-led online discussion system's Question View page (Left); Figure 5.6 The interface of student-led online discussion system's Asking Question page (Right up); Figure 5.7 The interface of student-led online discussion system's Comments reply page (Right down).

The second part of the framework shown in Figure 5.3 is the “Task Section”. The reason this section was created was to allow teachers to publish some tasks for students to explore or answer. The only difference from the “Question & Answer” section was that the teachers created the questions. The students could reply to the questions and review different questions and responses posted by other students.

In the system the “*About me”* function was implemented to enable a student to view all of the information created by them (see Figure 5.8). Students could index and review questions that they had created, replied to and followed. When the student clicked any number it invoked a different page. For example, if the student wanted to know the history of the questions that they have created they could click the number of the questions they had created. This invoked a page about the questions they had created sorted by date. Similarly, if students wanted to view the questions they had replied to or followed, they only needed to click the “check all” button and the relevant pages would be invoked.



Figure 5.8 The interface of student-led online discussion system's “About me” page

5.3.2 Teacher management system

The main functions of the teacher management system were to allow teachers to manage the student-led discussion learning system and create some new tasks for students (see Figure 5.9). Based on the E-safety concerns highlighted in Chapter 2, online bullying would lead students involved into an upsetting experience. The contribution management function was there to allow the teacher to manage the content if it involved online bullying or other inappropriate content. Teacher had the authority to view the content and delete it to avoid online bullying spreading (see Figure 5.10). Additionally, the function of "Create New Task" was, as the name suggests, to provide the opportunity for the teacher to publish some new tasks related to the school curriculum for students to explore.

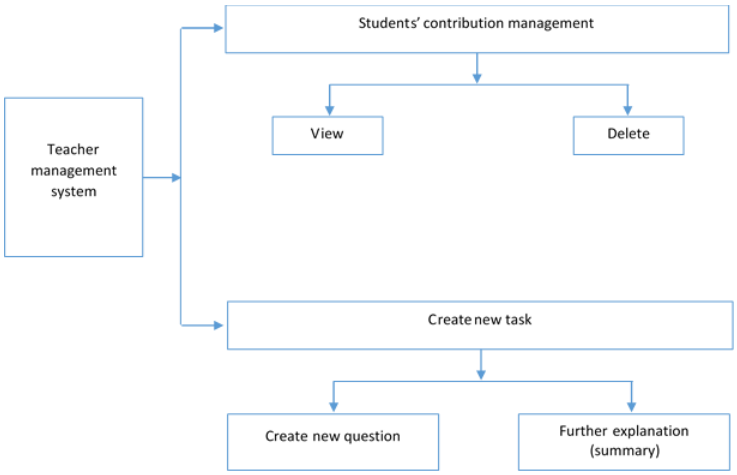


Figure 5.9 Teacher management system's framework for teachers

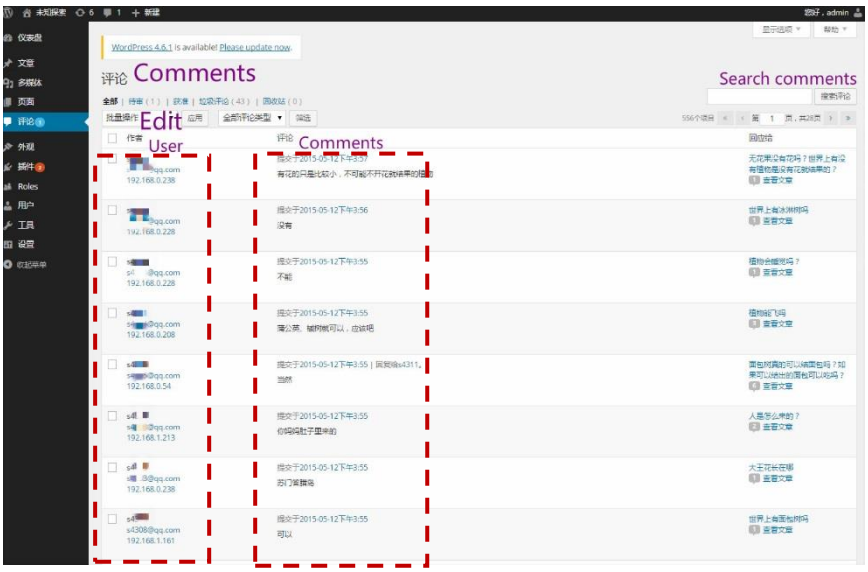


Figure 5.10 The interface of teacher management system's managing comments page

5.4 System implementation

This system was implemented based on the popular Content Management System – WordPress. The interaction data from users were captured in a PHP web script, sent to the server, and stored in a MySQL database. Below are some sample logs to illustrate how user's interaction data was stored in the database (see Figure 5.11, 5.12). The tables used were:

- *Posting table – aimed to record data relevant to the questions posted by each user.*
- *Commenting table – aimed to record data relevant to the comments contributed by each user.*
- *Reviewing Table – aimed to record data relevant to how the reviewing buttons ("Agree", "Disagree" and "confused") were used by each user to review each comment.*
- *Question viewing Table – aimed to record data relevant to what and how many questions were viewed by each user.*
- *User information Table – aimed to record data relevant to each user's information such as school and year.*

The information stored in the database helped to reveal students' interaction behaviour and contributed to the data analysis which is introduced in the following chapters. Students were able to make three different types of contributions during the discussion when using the system: ask question, post comments and review answers. A content analysis tool was used to analyse the log data in order to understand the interaction patterns and these are discussed in Chapters 6 and 8. Examples of database log entries provided by the system are given in Figure 5.11 for the activity of posting a question and 5.12 for posting a comment. The fields in each table include a key field with a name relevant to the table (for example post_ID for the posting table, comment_ID for the commenting table). They also have foreign keys to the user tables – for example post_author in the posting table is the user ID in the user table. The other fields log the relevant data for that table such as the question content (postcontent) and posting date and time (in post_date).

post_ID	post_author	post_date	postcontent	post_title	post_modified	comment_count
952	936	07/11/2015 12:16	How to make plants grow faster?	Growth of plants	08/11/2015 09:54	20

Figure 5.11 an example log of posting question

comment_ID	comment_post_ID	comment_date	comment_content	comment_parent	user_id
1803	823	31/10/2015 19:52	Destructive enthusiasm	0	520
1208	823	23/10/2015 20:59	It will make all plants die	1803	691

Figure 5.12 an example log of posting comments

The reviewing table (see Figure 5.13 for examples of individual entries) makes it possible to identify whether students had changed their understanding though clicking different buttons as a proxy to represent their ideas. In this particular example table entries record a student who originally clicked the "agree" button to question 1 at time t1 and then clicked "disagree" at t2 for the same question. This change of opinion was therefore revealed in the log data. This information helped to show the changes of student decisions.

record_voting_id	comment_id	user_id	time_click	type_click
9477	1369	486	30/10/2015 20:00	Agree
9478	1369	486	30/10/2015 20:00	Agree
9479	1369	486	30/10/2015 20:01	Disagree

Figure 5.13 an example log of reviewing

Additionally, when students did not actively ask questions or post comments to answer the questions the log information would reveal this. It was used to help identify how students used the buttons to review other students' comments. The log data also contained a pattern of viewing questions without contributing any questions, comments or reviews. Such behaviour was identified as inactive behaviour see Figure 5.14). This figure shows a record of how many questions students opened at a given time. While a particular student with user_id 509 had looked at question post 650 three times the

posting table revealed that this user never added a response – no relevant records appeared in the comments or reviewing tables.

record_ID	post_id	user_id	time_click
1364	640	509	29/10/2015 20:03
2542	650	509	31/10/2015 13:26
2550	650	509	31/10/2015 13:28
2557	650	509	31/10/2015 13:30
2561	593	509	31/10/2015 13:31

Figure 5.14 an example log of how many students viewed a question

5.5 Conclusion

This chapter explained the key component of the system designed based on the theory discussed in the literature review (in Chapter 2) and the result of the first study (in Chapter 4). The key components of the system and the key functions were discussed to show why the design was implemented and how it meets the requirements. Additionally, the interfaces of the system were presented to give an overview each component's key functions. Finally, the log information captured from the database was discussed. This reveals how records of the student actions were kept thus allowing the data analysis given in the following chapte

6 Chapter six

Peer discussion in technology supported learning environment

6.1 Introduction

Chapter 4 investigated how Chinese students (aged from 8-11 years old) were involved in the student-led discussion based on the face-to-face learning environment. Findings in Chapter 4 identified the overall view of the Chinese students' behaviour concerning participation and interaction. Based on the Chinese classroom teachers' feedback the participation rate was regarded as good compared with their responses in the traditional classroom discussion. It showed that Chinese students would voluntarily ask questions and give answers in student-led face-to-face classroom discussions. Although the role of Confucian culture may cause Chinese students to resist actively joining the discussion most students still preferred the new approach and showed their different ideas during the discussion. From the perspectives of interaction, eleven different reactions and different significant patterns defined from the method of content analysis and sequential analysis techniques were observed. These different reactions and significant patterns led to the creation of a new model of Chinese children's interactive reactions analysis based on the existing models. This model implied that it should focus on how to encourage students involve in a reciprocal process to generate explanation, justification and reflection rather than how to avoid incorrect information posted by students in the collaborative learning.

However, the findings in Chapter 4 also revealed the limitation of Chinese students' participation and interaction in the face-to-face learning environment. Based on the limitations discussed in Chapter 4, technology was proposed to scaffold Chinese students to enable them to behave better within the technology supported learning environment. Based on the theoretical review and findings from Chapter 4, Chapter 5 described how to design the technology supported learning platform to improve the

student-led discussion for Chinese students' participation and quality of interaction. This chapter presents an exploratory study on how Chinese students behaved when using the newly designed online discussion platform when discussion is student-led. It also investigated how the pattern of interaction differs between face-to-face discussion and online student-led discussion.

The following sections begin by describing the research questions proposed that lead to this phase of the research (see section 6.2). Next it will give detailed information about the research design of this study (see section 6.3). Following this it presents the result of this study (see section 6.4) and finally it discusses the results relative to the research questions (see section 6.5).

6.2 Research questions

According to the research questions described in the introduction (Chapter 1), the research questions to answer in this chapter are:

RQ3.1: How does the pattern of interaction differ between face-to-face discussions and online student-led discussions for Chinese students?

RQ3.2: How could induced cognitive conflict affect peer interaction and knowledge construction when technology-based intervention is applied?

6.3 Research design

6.3.1 Procedures

6.3.1.1 Student-led interaction through the technology supported learning environment setting

Each Chinese student was allocated a computer in the computer room and took part in a 40-minute session where they engaged in an online discussion about the development and growth of plants. Each session consisted of one year group resulting in a total of 9 sessions (3 per school). Before the observation study each Chinese student was allocated two papers (see Figure 6.1) and asked to answer the questions without using computers and looking for other resources. The purpose of this task was to act as a pre-test to measure students' prior knowledge and understanding level of each question. After 5

minutes the researcher collected the students' answer papers. Then the session began with the researcher giving a presentation to introduce how to use the online platform. During the introductory presentation the students were taught about the basic functions such as how to post a question and reply to a question or to make comments. The researcher also introduced two different sections highlighted in this online discussion platform. One section was called the pre-test section in which there were six questions listed that were the same as the questions previously asked on paper test. The researcher told the students that they could post their own answers or review other students' answer in this section.

The next section was called the question and answer section. In this section they were able freely to ask and answer questions about the plant growth topic. After 5 minutes of introduction the children were asked to use the platform to join in the discussion. The researcher did not force the students to ask or answer any questions. It depended upon the students whether they wished to post a question and make any comments. The researcher and the computer teacher were present to help the students when they had any problems using the platform. After the 40-minute session the researcher shut down all the computers that the students had used and asked them to answer the same paper test that had been used after the student-led discussion.

姓名(name)：_____ 班级(class)：_____ 学校(school)：_____

1. 为什么仙人掌可以在沙漠中活下来？
(Why cactus can survive in the desert?)

2. 怎么让植物快速生长？
(How to make plants grow fast?)

3. 植物吸收进去的水分去哪里了？
(where does moisture absorbed by plants go into?)

4. 为什么秋天的时候植物的叶子总会变成黄色？
(Why does the leaves of plants always turn yellow in autumn?)

5. 植物的生长是否需要阳光？
(Does the growth of plants need sunlight?)

6. 植物怎么样传播种子的呢？
(How does plants spread its seeds?)

Figure 6.1 Example of the questions delivered to students to do the pretest of their prior knowledge understanding level



Figure 6.2 Interface of online discussion platform

Questions and answers were kept in the database and transcribed before conducting the content analysis. The same coding scheme was applied to define the frequencies of different reactions that students had during this study as had been used for the previous study.

6.3.1.2 Interview on students' perception of cognitive conflict emerged from discussion

A total of 63 children attended the interview which was conducted after the observation study. Eight children from each classroom from Schools A, B and C. The main purpose of the questions designed was to ask the students to evaluate how functions of the three buttons designed in the online discussion affected their cognitive responses. The interview was conducted in each school's reading room. These rooms were quiet and also most students were familiar with these rooms. This was done to help them feel comfortable during the interview being in a familiar location. One student and the interviewer sat at the corner of a table. During the interview the discussion primarily addressed two situations to help the researcher gain an understanding of how the buttons affected the interviewee's reactions during the online discussion. The first was to ask what their reaction was when the students gave their own response to a question then discovered that their response was different from those of most other respondents. This response was labelled 'response to others'. This is represented in figure 6.6 as 'reviews to others'. The second element was 'response from others', which describes the situation in which a student writes responses to the question, after which others use buttons to express that they 'agree' or 'disagree' with, or are 'confused' about the student's responses.

6.4 Results

6.4.1 Participation patterns

There were, in total, 397 students attending this study; from this number 305 students participated to post answers to questions or reply to other students' answers during the discussion. In comparison an average of only 16 students stood up to answer the questions in the face-to-face classroom discussion. An average of 34 (SD=8.28) students who joined in to give their own ideas during the discussion. That is double the average number in the earlier study. The average number of comments that each class contributed was 217, which is five times the average number of replies per class in the face-to-face learning environment.

		N	No. Participation	Percentage%	No. Replies	MAXIMUM	MEAN	SD
3		41	16 (8)	39.0(19.5)	51 (19)	6	1.24	1.854
4	School A	41	35 (19)	85.4 (46.3)	226 (42)	17	5.51	4.749
5		39	26 (18)	66.7 (46.2)	94 (37)	18	2.35	3.278
3		43	33 (13)	76.7 (30.2)	166 (47)	12	3.86	3.556
4	School B	54	36 (17)	66.7 (47.2)	325 (47)	32	6.02	6.703
5		38	38 (13)	100.0(34.2)	418 (46)	22	11.00	4.514
3		44	37 (20)	84.1 (45.5)	117 (54)	15	2.66	2.925
4	School C	50	41 (18)	82.0 (35.3)	266 (57)	18	5.32	4.424
5		47	43 (19)	91.5 (40.4)	293 (56)	14	6.23	3.885

Table 6.1 overview of Chinese students' participation in online student-led discussion compared with participation of students in face-to-face student-led discussion

6.4.2 Interaction

A total 1602 comments and 129 questions were collected to be used in data analysis. Based on the system's database, there were a total of 376 questions and 1859 comments generated. However, 247 questions were not answered or only with one an invalid comments. The same coding scheme (explained in Table 4.1 in Chapter 4) was applied to analyse the quality of interaction. Based on the different learning environments of the students involved in this study, two additional categories emerged that were "grounded in" the data (see Table 6.2, highlighted in bold). The definition of "repeated answer" is difficult to state. Two possibilities of this term emerged during the discussion. Firstly, it is the exact copy from the other students' answers. The way that students posted is only because they agree with the other people's answer and also they want to show their agreement during the discussion. Secondly, it is the answer from them but it is exactly the same answer as others. Although their answer is the same as the others they still want to post their own answer during the discussion to present their opinions. This did not happen in the face-to-face learning environment, only in the online learning environment because each student has more opportunity to show their

own ideas whenever they can and they don't need to wait until others have finished the answering the question. This situation leads to more repeated answers posted in this learning environment. In the on-line study the term 'Distillation' emerged, meaning that some students liked to post their answer combined with different views from other students' answers after they have looked through the other students' responses.

Reaction	Definition of each reaction
Answering	A first statement used to answer the question.
Alternative Answer	A statement used to answer the question but irrelevant to the previous answer.
Extending	A statement used to extend and complement others' answers.
Agreement	A statement of agreement.
Disagreement	A statement of disagreement.
Evaluation	A statement that judges the accuracy, likelihood, validity, logic, relative importance or value of an argument or claim by 1) making explicit judgment with words like "good", "true", "not likely"; 2) raising alternative viewpoints from which to make judgments.
Inspiration	A statement of getting inspiration from others' answers and shows more information.
Question Complement	A statement to add more information to the question.
Questioning	A statement to query others' answers, but not show status of position.
Requesting	A statement to request more information to the questions or answers.
Summary	A statement to review or summarize points which arose in the discussion.
Repeated answer	**A statement is exactly the same as the others.**
Distillation	**A statement to combine the different points of view from others.**

Table 6.2 Improved coding scheme in the online learning environment

After using the improved coding scheme, the data collected from the online based learning environment was coded. The observed frequency transition in Table 6.3 shows the frequency among these different responses that are revealed in this study. The same method of sequential analysis was applied to get the significant pattern of interaction responses as was used for the data in the earlier experiment.

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	QUC	REP	DISW
ANS	0	29	27	9	6	8	1	19	43	15	1	3	0
ALA	0	31	20	11	7	9	6	23	35	36	0	11	13
EXT	0	12	24	7	1	4	8	11	19	18	1	10	8
QUE	1	11	2	2	2	3	0	5	6	18	1	2	1
REQ	1	5	0	2	1	1	0	1	2	5	0	1	1
INS	0	6	9	3	1	2	3	4	17	17	0	7	7
SUM	0	2	3	0	1	3	7	2	4	3	0	8	12
DIS	0	7	2	6	2	5	1	16	10	37	0	5	2
AGR	0	12	8	3	3	20	4	11	70	64	1	22	8
EVA	0	21	12	15	4	22	5	16	54	38	0	28	20
QUC	0	2	0	0	0	0	0	0	2	0	0	0	0
REP	0	15	8	6	1	6	5	8	18	23	0	75	37
DISW	0	10	11	4	1	6	10	4	23	20	0	27	44

Table 6.3 Observed frequency transition table in the technology supported student-led discussion

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	QUC	REP	DISW
ANS	-0.5	**3.5**	**4.4**	0.9	**1.8**	-0.3	-1.9	**2.2**	**2.7**	-3.1	1.0	-4.3	-4.3
ALA	-0.5	**2.6**	1.1	0.9	**1.8**	-0.7	-0.1	**2.2**	-0.6	-0.2	-0.8	-3.2	-1.6
EXT	-0.4	-0.2	**5.0**	0.8	-0.9	-1.2	**2.2**	0.6	-1.0	-1.1	1.3	-1.5	-1.2
QUE	**3.7**	2.5	-1.2	-0.2	1.0	0.0	-1.3	0.5	-1.5	**2.9**	**2.4**	-2.0	-2.0
REQ	**6.2**	2.2	-1.3	1.3	1.0	-0.1	-0.8	-0.4	-1.0	0.8	-0.2	-1.0	-0.7
INS	-0.3	-0.7	1.3	-0.1	-0.4	-1.1	0.4	-0.8	0.8	0.9	-0.4	-0.9	-0.1
SUM	-0.2	-1.3	-0.3	-1.4	0.2	0.3	**4.9**	-0.8	-1.7	-2.1	-0.3	1.1	**4.0**
DIS	-0.4	-0.9	-2.1	1.1	0.2	-0.1	-1.2	**3.7**	-2.1	**5.5**	-0.5	-2.1	-2.5
AGR	-0.6	-2.6	-2.6	-2.3	-0.7	**2.3**	-1.3	-1.6	**5.0**	**4.2**	0.6	-1.3	-3.3
EVA	-0.6	-0.7	-1.7	**1.8**	-0.2	**2.8**	-0.9	-0.4	**1.7**	-0.9	-0.8	-0.3	-0.6
QUC	-0.1	**2.6**	-0.6	-0.4	-0.3	-0.5	-0.4	-0.6	1.6	-0.9	-0.1	-0.8	-0.7
REP	-0.5	-1.4	-2.2	-1.0	-1.5	-1.7	-0.6	-2.0	-3.9	-2.7	-0.8	**11.4**	**4.5**
DISW	-0.5	-1.7	-0.5	-1.2	-1.2	-1.1	**2.4**	-2.5	-1.5	-2.0	-0.7	**1.8**	**8.1**

Table 6.4 Z- scores for tests of significance (when the z value of a sequence was larger than +1.65, it means that the degree of continuity reached statistical significance (p<.1)), in the technology supported student-led discussion

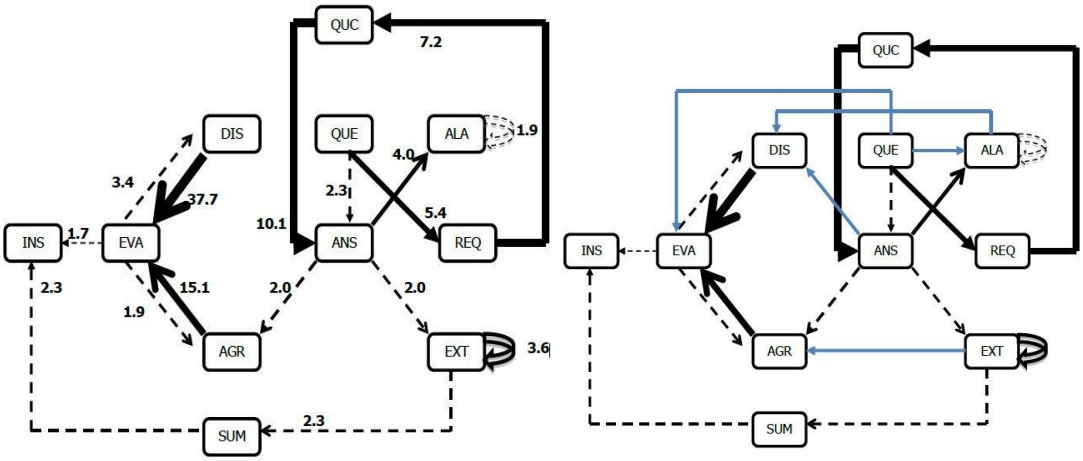


Figure 4.3 Response behaviour transfer from children when they answer the questions in the Face-to-Face student-led discussion (Left); Figure 4.6 Proposed technological intervention to improve Chinese children's interaction patterns (Right).

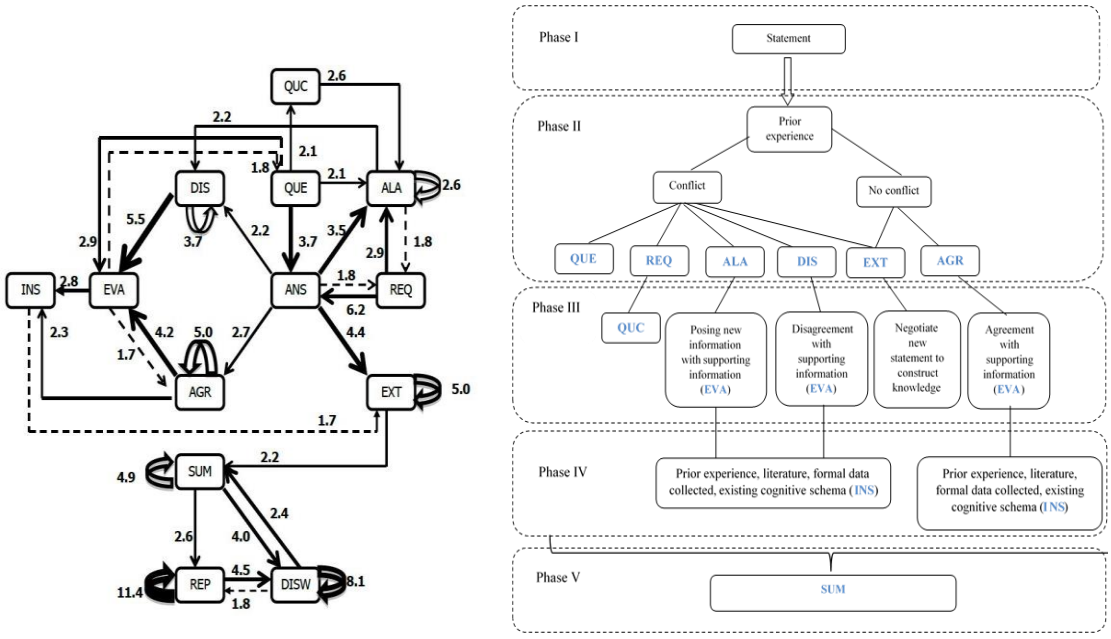


Figure 6.3 Response behaviour transfer from children when they answer the questions in the technology supported student-led discussion (Left). Figure 4.4 Model representing response patterns in the Chinese classroom (Right).

In order to compare the different patterns of interaction between face-to-face discussions and online student-led discussions, the results of the sequential responses behaviours in online student-led discussion (see Figure 6.3) would be analyzed compared to the sequential responses behaviours in the face-to-face learning environment's result (see Figure 4.3 in Chapter 4) and the expected sequential responses behaviour in Chapter 4 Figure 4.6 based on the students' interactive model (explained in Chapter 4 Section 4.5.2 Figure 4.4).

The result of sequential responses behaviour in online student-led discussion is similar to the expected sequential responses behaviour proposed in chapter 4, which implied that technology did support more interaction between students. There are four reactions which revealed significant different sequences with other reactions compared with the result of patterns in the face-to-face learning environment: disagreement (DIS), alternative answer (ALA), questioning (QUE) and summary (SUM). Three of them (DIS, ALA, QUE) are involved discovering of dissonance process in phase two of children interactive model.

In the face-to-face learning environment, the reaction of Alternative Answer only led to itself (see Figure 4.3). There were no additional significant reactions following this reaction of Alternative Answer, which also regarded as the limitation about making students find difficulty in judging whether this information posted by students is incorrect. However, in the online learning environment, many reactions emerged which were followed or leaded to the reaction of Alternative answer. For example, the reaction of alternative answer leads to three reactions of disagreement (ALA → DIS), requesting (ALA→REQ) and alternative answer (ALA→ALA). Two examples adapted from the students' online discussion transcription to illustrate how different reactions that students performed in the two different learning environments regarding with one same question (see Table 6.5 and 6.6). The same question that student asked is *"How to make plants grow faster?"*. In the face-to-face learning environment (see Table 6.5), there is no further discussion after the statement of "make plants listen to music" as the reaction of alternative answer. Students pointed out the idea that there is no way to make plants grow quickly with the evaluation of too many nutrients causing plants to die. Other students also added their different ideas to extend the standpoints as to why too much nourishment did not work. The following reactions of alternative answer were pointed out without further discussion.

However, in the online learning environment (see Table 6.6), many students joined the discussion to argue what kind of method could make plants grow faster. Only a part of the discussion of whether music can make the plants grow quickly has been presented in the Table 6.6. Firstly, students used idiom they learnt before or read from a story to argue over the comment that 'Destructive Enthusiasm' is not a good way to make the

plants grow more quickly. Students were inspired from the story they read and were able to put forward further evidence to back up their arguments. In the online learning environment students also mentioned that "music can make plants grow quickly" as an alternative answer. In contrast to the face-to-face learning environment there were further reactions involved in evaluating this alternative answer. For example:

"Cannot let some plants listen to the music. Only for the specific plants"

The year 5 students disagreed with the alternative answer that a year 4 student had expressed. Although the student mentioned that this is only for specific plants, they did not point out which plants were specifically suitable, or not, for listening to music. However, another year 5 student argued that "*No. It should be correct and I saw it from the book before, music can help plants grow*." His argument was that he read it in a book and that provided evidence to support the statement "*music can make plants grow quickly*". The following reaction was to combine the four factors such as water, sunshine, nutrition and music as the conclusion in answering the question. The reaction of question and evaluation was argued by a year 4 students to narrow the question of whether music can make plants grow quickly. He asked what kind of the music would make plants grow fast if there is a specific plant that cannot grow quickly with this kind of stimulation. In addition, he mentioned that rock music is not suitable for plants. During the process of the discussion there was a very strong negotiation between each student to define whether music can make plants grow faster and what type of music would make it grow or not. At that point a year 3 student asked whether it is ok to let plants listen to music. It seems that the year 3 students were confused or were experiencing a confrontation of their knowledge with this conflict. Following on from this, an argument from a year 5 student stated that *roses cannot listen to music* and the evidence showed that tomatoes can grow very well after listening music. After the negotiation and argumentation between students, two year 5 students reached the summary statement given in table 6.6 below.

The examples from these two different learning environments are used to illustrate that there was further interaction following the reaction of alternative answer and question in the online environment. As seen from Figure 6.3, there are more interactions with each student member involved culminating in both conflict and agreement in a given situation.

Question: how to make plants grow faster?

Transcription	Reaction	Year
It's impossible	Answer	Year 4
Make the plant have more nourishment	Alternative answer	Year 4
I think no matter how, there is no way to make plants grow quickly. Because if added more nutrients, they will wither and die	Disagreement Evaluation	Year 4
And adding too much nourishment will be contrary to the life cycle of the species and it may then be on the variation	Extending	Year 4
As for nourishment, it just helps the process of photosynthesis.	Extending	Year 4
I think if you want to make a plant grow rapidly, if you really want this, it is best to find one kind of hardy plants with fast propagation to cross-fertilize with it.	Alternative answer	Year 4
Make plants listen to music	Alternative answer	Year 4

Table 6.5 A discussion example from student -led face-to-face discussion

Transcription	Reaction	Year
Destructive enthusiasm	Answer	Year 5
It will make all plants die	Evaluation	Year 5
Destructive enthusiasm would make plants absorb less nutrition or, at worst, lead to death	Evaluation	Year 5
Yes. This is the idiom from the story. In the story, someone want to the plants to grow quickly, so he pulled up seedlings to help them grow, finally, the plants died.	Agreement Inspiration	Year5
Add more water	Alternative answer	Year 3
More sunshine as well	Extending	Year 3
Moderate nutrition and put it under the sunshine.	Distillation	Year 4
Make plants listen music	**Alternative answer**	**Year 4**
Cannot let some plants listen to the music. Only for the specific plants	Disagreement Evaluation	Year 5
No. It should be correct and I saw it from the book before, music can help plants grow.	Disagreement Evaluation	Year 5
Let plants listen to music, add water, moderate nutrition and put under the sunshine	Summary	Year 5
Yes. I read the book before, it mentioned that one scientist let one plant listen to music which makes plant grow very well.	Agreement Inspiration	Year 4
How do you know what kind of music the plant like? Some plants cannot listen to the rock music which makes plants die.	Question Evaluation	Year4
Is ok to let plants listen music?	Question	Year 3

I read one book before, which showed that tomatoes grew very good and sweet after listening to music.	Inspiration Evaluation	Year 5
No, for example, if let a rose listen to the music, it will make it die	Evaluation	Year 4
Cannot only let plants listen to the music, it also need sunshine and water	Disagreement Evaluation	Year 5
I think to make plants grow quickly is to give a good environment such as enough sunshine and nutrition.	Summary	Year5
I think to make plants grow quickly is to give a good environment such as enough water, sunshine and nutrition. Properly, let plants to listen music (must be proper for the plants. For example, rock music for rose would lead it to die quickly). Combining these different factors the plants can grow quickly than others.	Summary	Year 5

Table 6.6 A discussion example from technology supported student-led discussion based on the same question

The reaction of questioning also highlighted in the online learning environment is in contrast to the face-to-face learning environment. The reaction of questioning has significant patterns with question complement (QUE → QUC), evaluation (QUE→EVA), alternative answer (QUE→ALA) and answer (QUE→ANS). It seems that the reaction of questioning helps children more actively join in the interaction, allowing them to evaluate the information shared and post new standpoints. In addition, the reaction of evaluation also leads to the reaction of questioning. This reciprocal process of challenging and questioning each other's reasoning and viewpoints could achieve the construction of a shared understanding of knowledge.

In the fifth phase, there is a big difference between the result from the face-to-face learning environment and the online learning environment. In the online learning environment additional reactions of repeated answer (REP) and distillation (DISW) were revealed in the transition diagram (see Figure 6.3). The reaction of repeated answer significantly leads to itself (REP→REP) and Distillation (REP→DISW). The highest weight of the pattern from repeated answer to itself is 11.4. Ideally, a repeated answer means that the answer is exactly the same as others. However, the reaction of repeated answer is very difficult to identify. For example, on the one hand children have exactly the same answer as others but also want to show their own standpoint online to agree with others. This answer should, therefore, be treated as agreement behaviour rather than plagiarism. On the other hand some children copied others' answers as their own ideas during the discussion.

Based on the transition diagram the children's interaction during the online discussion can be divided into two parts. The first part can be seen as active discussion which involved different reactions in a way that was similar to the face-to-face learning environment. The second part of the discussion involved most reactions of summary, repeated answer and distillation. This is believed to indicate that children may have already achieved a certain understanding of what they thought was the answer to the question after active discussion and so more repeated answers or agreement appeared in the following discussion.

6.4.3 Factor of more knowledgeable others (MKO) in significant interaction pattern

As discussed in the Chapter 4 Section 4.6, homogeneity of the group regarded as the potential factor cause the limitation of significant pattern of interactions in the face-to-face learning environment. Based on the Vygotsky's (1980) theory discussed in the Section 2.3.1.1 in Chapter 2, the more knowledgeable others (MKO) introduced in this technology supported learning environment by asking students from different year join the discussion. In order to review how the factor of more knowledgeable others (MKO) involved would effect on the significant pattern, students were asked to answer the preset questions before the student-led discussion. There were two main reasons to ask students to answer the questions. Firstly, it can ascertains students' prior knowledge understanding level which helps to find out the relationship between different prior knowledge understanding levels with reactions, and the different years that the students were in. Secondly, it helps to find out whether different views that were posted, especially those providing incorrect information would mislead students' understanding. This would be achieved by comparing and contrasting their pre-test and post-test scores. The following sub sections, firstly allowed the pre and post-test results to be compared to find any significant differences. Secondly, it illustrates how students who were already knowledgeable in the area had different reactions to the less knowledgeable students. The different years the students were in and different prior knowledge the students had were evaluated against the different reactions that they exhibited in the student-led discussion.

6.4.3.1 Pre-test and post-test of students' understanding change after using online student-led discussion

The pre-test and post-test questionnaires that students answered and the different reactions that students performed based on the pre-set questions produced a total 646 observations. Due to some students not showing any reactions in the online learning platform observations of these students only recorded their performance of pre-test and post test scores. A paired samples t-test was conducted to evaluate the impact of the technology as an intervention to allow students to interact with each other to discuss the various answers to the questions on students' understanding of each question. There was a statistically significant increase in rating of students' understanding of each question from pre-test (M= 2.28, SD=1.244) to post test (M= 2.69, SD=1.179), t (645) = 13.451, p <0.000. The eta squared statistic (0.22) indicated a large effect size.

6.4.3.2 Relationship between more knowledgeable other and reactions they performed during student-led discussion

In contrast to the student-led face-to-face discussion in which only students from the same class were involved in each discussion, three different year groups of students were asked to join the discussion in the student-led online discussion. This was designed to increase the possibility for more knowledgeable others to be involved in the discussion. As section 6.4.2 showed difference between the significant pattern between face-to-face student-led discussion and online discussion. Statistical analysis was applied to evaluate how the presence of different year groups and different levels of previous knowledge that the students ha affected their reactions (see Figures 6.4 & 6.5). It seems clear that students from Year3 had higher frequencies of the reactions of questioning, repeated answer and disagreement than students from Year 4 who had higher frequencies of the reaction of evaluation and distillation. It is surprising to note that students from Year 5 only had higher frequencies in the reaction of inspiration.

The different levels of preconception of questions evaluated in the pre-test (1 is lowest level of understanding, 5 is highest level of understanding) highlights that the lowest level of understanding led to a higher frequencies in the reaction of disagreement and evaluation and highest level of understanding led to higher frequencies in the reactions of requesting, summary and distillation. The higher level of understanding led to higher

frequencies in the reaction of inspiration and questioning.

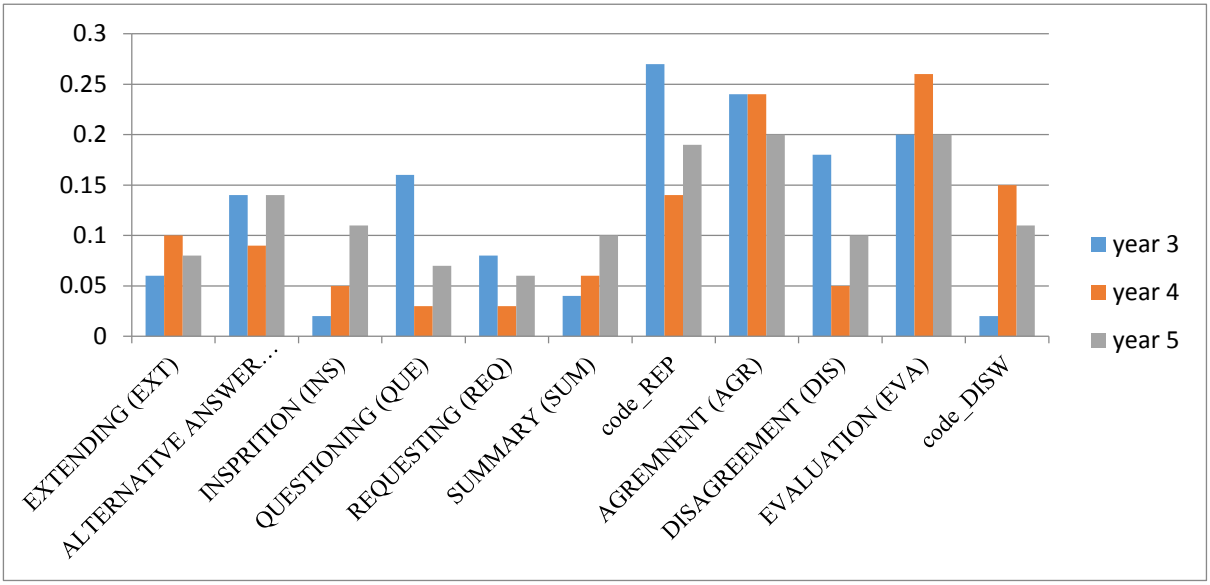


Figure 6.4 Mean of frequencies of each reaction that different year student performed during the discussion

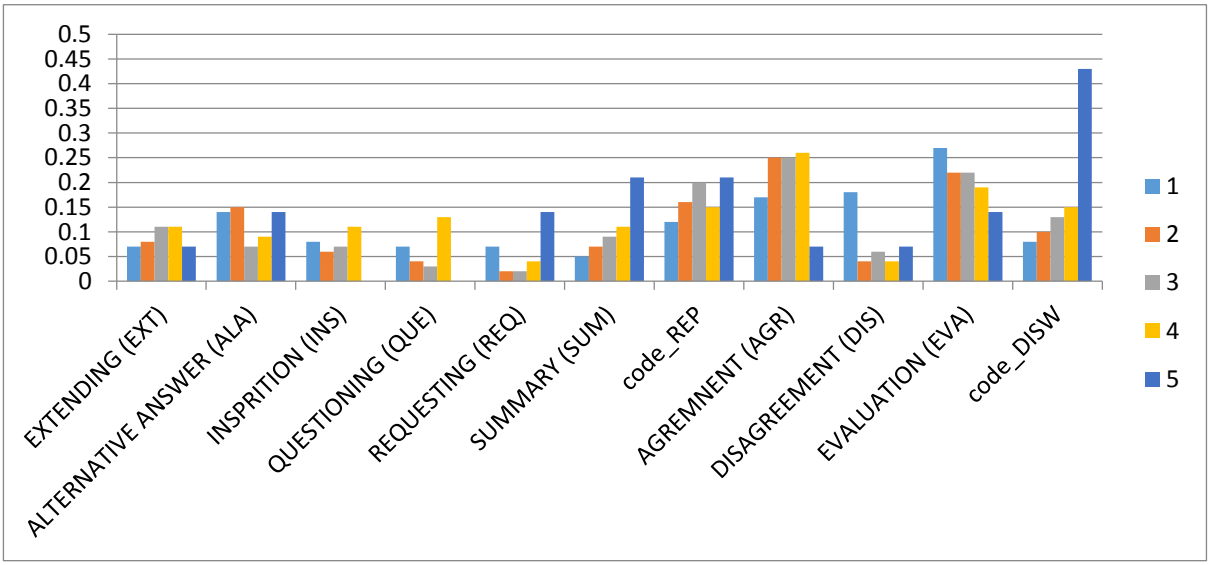


Figure 6.5 The mean of frequencies of each reaction that different levels of preconception that students have during the discussion

The methods of ANOVA were applied to identify what reactions that students performed were significant when students' prior understanding level and different years that students were from as the independent valuable, which helped to discuss why significant patterns were different compared with the face-to-face discussion environment when students from different year joined together.

The results for the following reactions were: *Inspiration* F (2, 453) =3.418, P=.034; *Questioning* F (2,453) = 5.753, P=.003; *Disagreement* F (2,453) = 4.039, p=.018; and *Distillation* F (2,453) = 4.039, p=.018. Based on the different levels of prior understanding that students had, the significant reactions were *Disagreement* F (5, 450) = 2.477, p=.031, and *Distillation* F (5,450) = 2.922, p=.013.

Also, the results of the relationship between preconception of knowledge with different years showed that higher year students did not have a higher level of preconception of the knowledge, F (2,453) = 9.251, p = .000 (Year 3 (M=1.51, SD=1.281); Year 4 (M=2.32, SD=1.158); Year 5 (M=2.10, SD=1.326). The students from Year 4 did have significantly higher levels of prior understanding than students from Year 3. The average level of understanding of the students from Year 4 (M=2.32, SD=1.158) was higher than that of students from Year 5 (M=2.10, SD=1.326).

Based on the overview of the results, students from Year 3 had higher frequencies of the reactions of questioning, inspiration and disagreement compared to students from Year 4. Students from Year 3 and Year 5 had higher frequencies in the reactions of alternative answers, questioning, requesting and disagreement. Students from Year 4 had higher frequencies in the reaction of evaluation. As the results show students from Year 4 had higher levels of prior understanding compared to the students from Years 3 and 5. They preferred to be involved in the negotiation phase to evaluate their answers. The reactions from Year 3 and Year 5 students involved conflict and showing different reactions to negotiate with others to solve cognitive conflict.

6.4.4 Result of the interview with students about their cognitive experience with buttons designed in the technology supported discussion platform

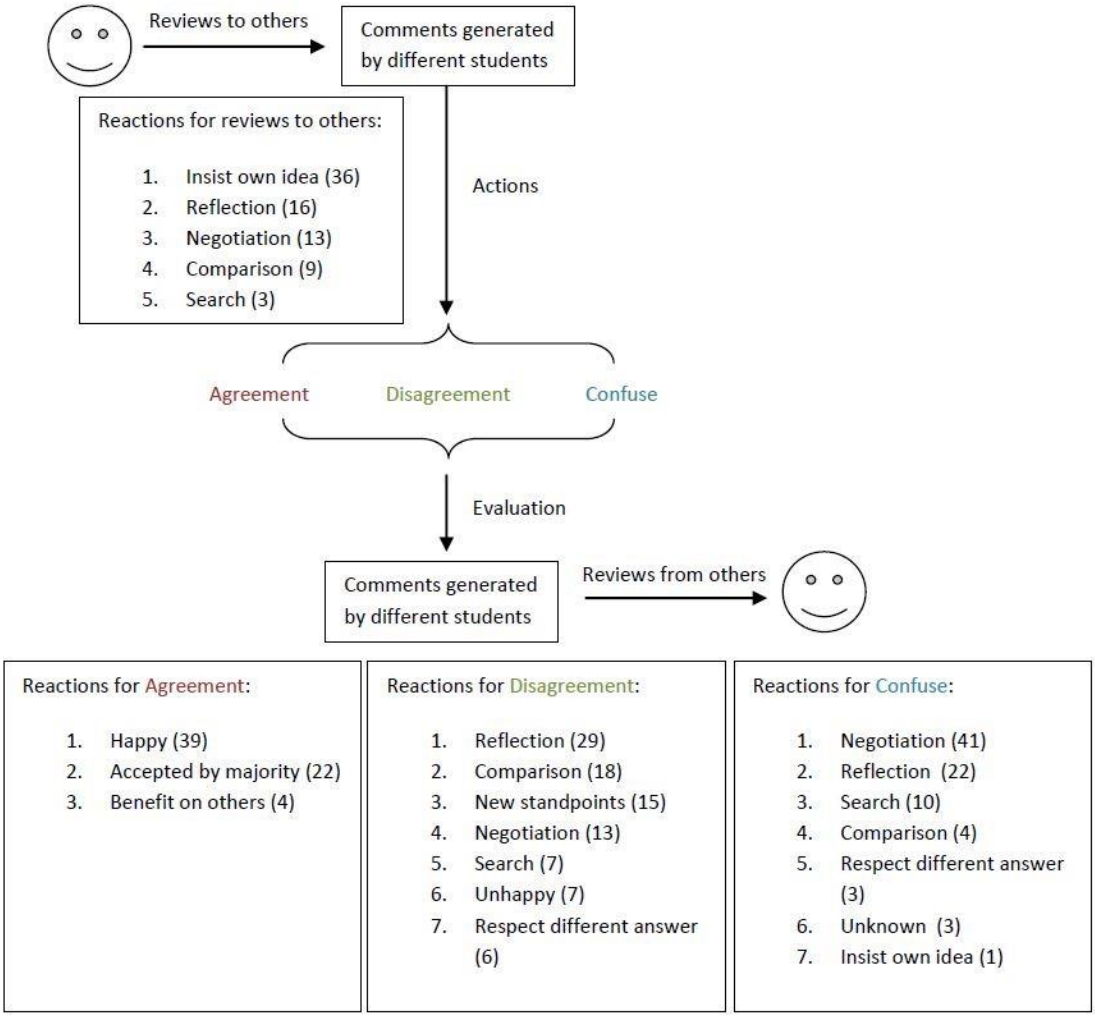


Figure 6.6 Frequency of categories of codes for when children are in different conflict situations

Based on the thematic analysis there were different categories identified related to the different circumstances they experienced (see Figure 6.6). After reviewing the different categories emerging from the different circumstances four prominent characteristics of the students' reactions were seen. These were *Comparison, Negotiation, Reflection and Search.* These were the same whether they were viewed in terms of 'response to others' or 'response from others'. Below the similarities of the three types of circumstance are discussed. After this the differences in reactions that occurred in differing circumstances are analysed.

6.4.4.1 Similarities and difference of reactions revealed in different circumstances

As previous Section 6.4.4 discussed, students showed reactions of *Comparison, Negotiation, Reflection and Search* when they confront with conflict no matter when they review other students' comments or when they got review from other students. In the Figure 6.7, it included students' interview transcription which explain how they will react in different circumstances.

Comparison: The reaction of comparison mainly is about that students try to compare and contrast the information between their ideas and those of others, to review their own responses when they confront with conflicting information. There are two specific actions that students pointed out during the interview based on the reaction of comparison (see figure 6.7). Firstly, they said that they want to compare and contrast how others respond during the interaction (e.g. *"I just look to see what other people's responses are like.")*. Secondly, they would compare and contrast their own ideas with the knowledge they had found from the ligature or online, and tested it or asked their teachers or parents to check whether there were any faults in their own ideas.

Negotiation: The reaction of negotiation occurred mainly in two forms. Students prefer to negotiate with others to explain their ideas or to ask why other students disagree or confuse with their answers when they received 'disagree' and 'confuse' from other students (e.g. *"I'll go and ask them why they disagree with my answer.")*. On the other hand, students mainly focused on explaining the difference between their answer to others or justify their answer when they confront conflicting information by reviewing other students' comments (e.g. *"I'll just go ask them, to see where they confuse with. Then we can figure out the correct response together."*).

Reflection: The reaction of reflection is more relative to the affection of student's cognitive experience to review their own idea. There are three main cognitive reflections on students' own responses discussed from interview. Firstly, students consider whether their responses were correct or not (e.g. *"I will want to check whether or not I was mistaken, or whether they have a problem"*). Secondly, they consider how their responses need to be improved (. Thirdly, they consider where or why their

responses were challenged by other students (*"I will first consider why their idea is different from my own. After I've done enough research to understand, I'll make my decision."*).

Search: The reaction of search that students mentioned from the interview focused on seeking help. They try to seek other methods to help them resolve the conflict. Based on the transcription from the interview, most perspectives that student mentioned seeking help from were from their teachers, parents, classmates, the internet, literature and their own experiments and investigations.

Reactions	Review to others	Review from others	
		Disagreement button clicked	Confusion button clicked
Comparison	*"I first consider my own response, and then look at others' responses. Finally, I compare them."*	*"Well, I think I may be mistaken, and I also want to look at my classmates' responses and think about where I'm wrong, and where I need to make improvements."*	*"I just look to see what other people's responses are like."*
Negotiation	*"It could be that our thinking is different. I think that I'm right; they think that I'm wrong. Maybe I'll reply to some, to figure out the reason."*	*"I'll go and ask them why they disagree with my answer."*	*"I'll just go ask them, to see where they confuse with. Then we can figure out the correct response together."*
Reflection	*"I will first consider why their idea is different from my own. After I've done enough research to understand, I'll make my decision."*	*"I will want to check whether or not I was mistaken, or whether they have a problem"*	*"If they click "confuse", it could be that they didn't really understand my point."*
Search	*"I'll Baidu it first, and then decide whether I got misconception about my own idea in my mind."*	*"I'll check it online to figure out whether I or other students provide wrong answer."*	*"I will go to search the relative information from the literature firstly, and then to see whether I explained clearly from my responses."*

Figure 6.7 Summary of four prominent characteristics of the students' reactions in different conflict situation with the examples adapted from students' interview transcription.

There are different reactions that have not been mentioned above that will also be discussed in the following section to explain some of the different reactions that students performed in these three different circumstances.

As summarized in Figure 6.6, the highest frequency of behaviour that students mentioned when they confront conflict by reviewing other students' answer is **insisting on their own answers**. For example, one statement adapted from the interview's transcription highlighted that "*it is ok for me. My answer is my own idea; their idea is theirs. The only thing I can do is to prove my answer is correct by arguing with them."* There is another student who stated that "*Because everyone has their own standpoints, so I will insist my own answer, even I think this student's answer is wrong but most students click agree, I will still click disagreement button under his comments*." Based on the interviewee's comments, it seems that most students will still insist on their own answer and click the corresponding button relative to their own idea no matter whether their idea conflicts with the majority of students' standpoints.

In the circumstance that other students clicked the disagree button under students' comments, there are three additional categories that students talked about during the interview: **respect different answer**, **new standpoints** and **unhappy**. Six students pointed out that it is very normal to have different answers from others, so they respected that the different answer contrasted with their answers. 15 students pointed out that they want to change their existing answer by posting a new correct answer ("*I will compare it firstly, if I found my answer is incorrect or need to improve, I will change my answer and to post a new answer*"). There were also some students who indicated that they would feel unhappy when another student disagreed with their answers.

In the circumstance that other students clicked the confuse button under students' comments, there are three additional categories with lower frequency that students pointed out: **respect different answer**, **insisting on their own answers** and **feel unsure of the answer.**

Categories identified from another circumstance that is different from the abovementioned is when another child clicks the 'agree' button under students' comments. According to Table 6.7, it can see that most children felt **happy** and thought

that their answers have been **accepted by majority of students**. A small group of students will feel that their contribution in the discussion **benefits other students' understanding**.

Category	Frequency
Accepted by the majority of students	**22**
Benefits others' understanding	4
Happy	**39**

Table 6.7 Frequency of categories of codes when peers click on the 'agree' button

6.4.4.2 Different patterns of reactions revealed in different circumstances

As discussed in Section 6.4.4.1, it was found that several similar behaviours were exhibited when students were confront with confliction in three different circumstances. Additional, based on the transcription of students' answer from interview, there are certain patterns between these different behaviours. This can be seen in the following example: "*I will Google it firstly, and then decide whether I misunderstand the knowledge*". There are three reactions of **search**, **comparison** and **reflection** involved in this example. First of all the student intends to **search** for some relevant literature, then they will **compare** the results of this search with their initial answer and, finally, **reflect** on whether their answers may be wrong. Based on the sequence of each reaction that students mentioned from their transcriptions, the Figure 6.8 provides the overview of each different pattern revealed when students confront conflict in different circumstances.

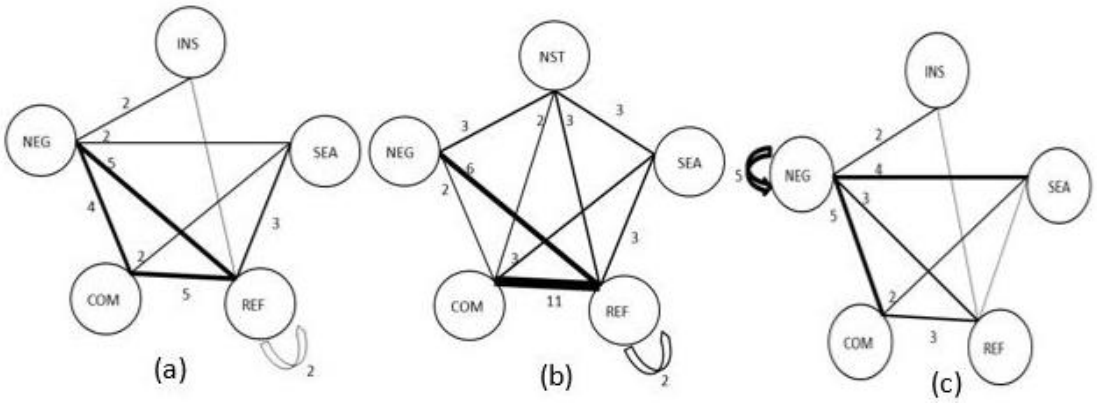


Figure 6.8 (a) Reaction patterns revealed when children gave review to others, (b) reaction patterns revealed when other children clicked the 'disagree' button to review the answer; (c) reaction patterns revealed when other children clicked the 'confuse' button to review the answer

As explained in Section 6.4.4.1, the highest frequency of reactions that students take is insisting their own answer when students encounter conflict when reviewing to other students' comments. In Figure 6.8 (a), it also showed the pattern between the reaction of insist own idea (INS) with other reactions such as negotiation (NEG) and reflection (REF). Additional, there are also strong relationships among reactions of negotiation, comparison and reflection.

There are different reactions generated involving confliction when the students' answer is reviewed by others. As shown in Figure 6.8(b), when a student's comment is reviewed by clicking the "disagreement" button, there is a strong connection between reactions of comparison (COM) and reflection (REF), as well as between reactions of negotiation (NEG) and reflection (REF). When others click "confuse" on a student's comment, the reaction pattern becomes different compared with when others click the "disagree" (see Figure 6.8 (b) and (c)). It is clearly showed that the other reactions have a strong link with negotiation (NEG). Thus, it is clear that when others click the 'confuse' button, this could instigate negotiation behaviours, as well as relatively strong comparison and search behaviours.

6.5 Discussion

This chapter has investigated how Chinese students interact in technology supported student-led discussion. This sections discuss the findings in responses to the research

question highlighted in section 6.2: *RQ3.1: How does the pattern of interaction differ between face-to-face discussions and online student-led discussions for Chinese students? RQ3.2: How could induced cognitive conflict affect peer interaction and knowledge construction when technology-based intervention is applied?*

Based on the results discussed in Section 6.4, it can summary two main reasons help to increase students' interaction with supporting of technology. The first one is that technology provide the opportunity to allow students from different year join the discussion. The second one is that the factor of cognitive conflict induced by technology supported discussion, which plays an important role in peer interaction and help to promote the collaborative discussion. In the following Section 6.5.1 and 6.5.2 will explain why and how these two reasons help to increase students' interaction with supporting of technology based on the results discussed in Section 6.2.

6.5.1 Factor of different years and previous experience influence on the different pattern of interaction

As homogeneity of the group identified as the factor caused the limitation of significant pattern of face-to-face student-led discussion, students from different year are encouraged to join the discussion together. Based on results shown above (in Section 6.4.2 and 6.4.3), it highlighted that students from year 3 have higher frequencies in reaction of questioning, inspiration and disagreement compared to students from Year 4. Students from Year 3 and Year 5 have higher frequencies in the reaction of alternative answers, questioning, requesting and disagreement. Additional, the reactions of questioning, disagreement and alternative answers are significant different in comparing with significant patterns resulting from the face-to-face learning environment and online learning environment.

These reactions of questioning, disagreement and alternative answer played a critical role in facilitating learners' reflection and knowledge construction process (explained in Section 6.4.2). For example, the reaction of alternative answer can provide more possibilities of answers for students, which can encourage them to clarify each different possibility and come to conclusion by themselves (Fosnot & Perry, 1996). Additional,

the reaction of questioning helps to seek missing information from learners' explanations and promote learns to consider various contexts and perspectives for each problem when learners engender cognitive dissonance or "epistemic curiosity" (Chin & Osborne, 2010b; Choi, Land, & Turgeon, 2005; O'Hanlon & Diaz, 2010). The reaction of disagreement helps to promote negotiation of meaning in the following phases which highlighted from children interactive model.

The reaction of inspiration also highlighted as significant result based on the factors of different years that the students were from and the different level of prior understanding they had. The reaction of inspiration is in fourth stage of the model of children's interactive reactions (Figure 4.4 in Chapter 4). This reaction focuses on building the connection between the knowledge students learn from the discussion to the knowledge they learn from their daily life. The greater reaction of inspiration that students performed in the discussion can help to promote reflection on the literature they read, the experiment they conducted and the experience they had before.

Finally, the reaction of distillation is significant on the higher level of knowledge understanding. For example, a Year 4 student is significantly higher than the Year 3 and the highest level of preconception is significant than other levels of preconception based on the result of statistics. The conclusion can be that students with a higher level of knowledge are more likely to summarise their idea or distillate the ideas from others.

In the technology supported student-led discussion, it promotes students from different years with different previous knowledge level together. As discussed before, the reactions are performed differently between these two learning environments are questioning, disagreement, alternative answer, inspiration and distillation. The reactions of questioning, disagreement and alternative answer are involved when students confront with cognitive dissonance in the process of interaction. It seems that cognitive conflict is easier induced which lead students to show their different standpoints and request more information to solve their cognitive conflict in the technology supported discussion. The reactions of inspiration and distillation are involved transferring and reflecting the knowledge on their existing knowledge, which promote deeper knowledge construction.

In the following section, it will further illustrate how cognitive conflict influences students' reactions during peer interaction.

6.5.2 How cognitive conflict influences students' reactions during peer interaction

As summarized from previous section 6.5.1, the significant patterns that students performed different in comparing two different learning environment, implied that students confront with more cognitive conflict when students from different year join the discussion. In this section, it will discuss how cognitive conflict induced would influences students' reaction during peer interaction.

Cognitive conflict was widely discussed by many researchers as a strategy to help students to achieve conceptual change in Chapter 2 Section 2.3.4. However, the effectiveness of this strategy is debatable and the main method that many researchers adopted was to passively given contradictory information to prompting them to reflect in order to resolve their own self-doubt. Based on the significant patterns revealed from the online discussion (see Figure 6.3) and reaction patterns summarised from the result of interview (see Figure 6.8), the model is designed to explain how the role of cognitive conflict played in the process of dynamic interactions among students to promote reciprocal process in online student-led discussion.

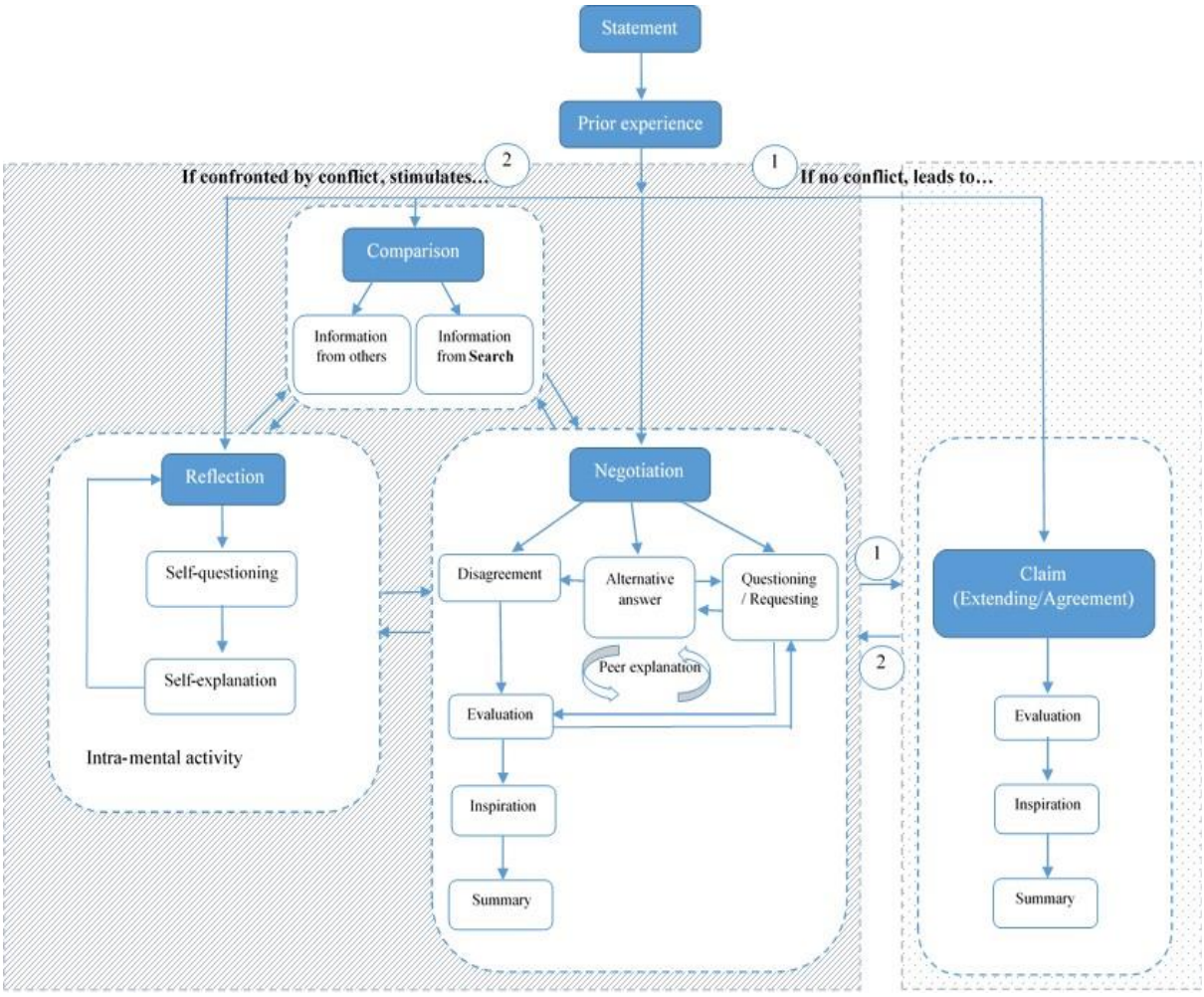


Figure 6.9 Cognitive conflict --- peer interaction model showing the role of cognitive conflict in supporting online discussion

Figure 6.9 shows the initial elements of a model (referred to as CP or cognitive conflict – peer interaction model) that offers a possible representation of how the role of cognitive conflict in the peer interaction is to promote peer negotiation and knowledge construction during the discussion. In the CP model, a statement presented to students serves as a source of data. This statement could be in the form of any reactions that the students performed to answer the questions, or their standpoints. Based on the students' prior experience, students may or may not confront with cognitive conflict. Two possible major routes may then occur based on whether students confront with cognitive conflict. If the individual did not confront conflict to previous experience which was regarded as pathway 1, he/she may make a public explanatory claim which is similar to the reactions of extending and agreement in the model of children interactive responses.

This claim may also be further elaborated in the cognitive conflict process, which is also highlighted as pathway 2 and leads to the cognitive conflict section.

Alternatively, if the individual confronts with cognitive conflict which is regarded as pathway 2, there are three possible major routes which may then occur based on the results of interview: comparison, negotiation and reflection.

In the comparison process which already explained in Section 6.4.4.1, students may compare their own standpoints with others firstly to find out the difference. Alternatively, students also try to search information to find solutions to prove whether their own idea is correct or not.

Alternatively, cognitive conflict also leads to the generation of reflections on a sequence of intra-mental events. Here reflection may then elicit a self-question posed by the individual to himself or herself. In this situation, they will reflect on whether their answers are wrong or not, whether they explain clearly or not, which subsequently leads to a self-explanation or monologic argument. However, this process may encounter further reflection, which generates another self-question and self-explanation. Research elsewhere (Chi, 2000; Chi, Bassock, Lewis, Reimann, & Glaser, 1989; Chi et al., 1994) has shown that the cognitive activity of self-explanation supports knowledge construction. Self-questions and self-explanations may be overt or covert, depending on whether they are externalized.

Alternatively, instead of talking to himself or herself, the student may engage with others by verbally articulating the disagreement, providing an alternative answer and asking a question to them, which would then elicit a peer explanation in the negotiation process. The reactions involved in the negotiation process are from phase III of the model of the children's interactive responses. The direction between each different reaction is also adapted from the significant pattern of online discussion (see Figure 6.3). During the process of negotiation, students also build knowledge construction based on each other's ideas. Each reaction that an individual involved in the conflict section also leads to the assimilation process which is regarded as pathway 1 and leads to the no conflict section. It is iteratively process between the process of assimilation and accommodation.

However, it is also possible that students' conflicts are ignored or not responded to. Consideration should be made for the situation where a student would not encounter any conflict during discussion due to limited previous experience. If a student was involved in any of the cases explained above, and there was no further follow up activity, this would result in no reaction being performed, which is not represented in the diagram.

This model helps to define how students would become involved in interpersonal and intrapersonal processes and how the role of cognitive conflict would promote negotiation and knowledge construction during peer interaction, which could help to promote reciprocal process to review each other's standpoints. The elements of this model are iteratively relative to each other. As Vygotsky highlighted in his theory (O'Donnell & King, 2014), social and individual process is interdependent in the co-construction of knowledge. During the discussion, students will be involved in both an interpersonal (social, interactional) and intrapersonal (individual cognitive capabilities) process (Barron, 2000; Howe & Mercer, 2007). The important feature of this model is that each element is relative to each other and interactively involved in the knowledge construction process. Although the intra mental and inter mental processes are represented separately, the model shows that it is possible to move between these different elements when students are involved in peer interaction.

Additional, from interview result discussed in Section 6.4.4.2, it showed that the three buttons made a contribution to the process of students' interaction. Firstly, the three buttons help students simply express their own ideas by clicking buttons. As explained in Chapter 2 Section 2.4.2, some Chinese students did not have much experience by using computer. They may found typing difficult or were unsure how to express themselves in their comments at first, so they can use buttons to quickly express their point of view. Secondly, the 'agree' button designed helps students to achieve a certain level of self-confidence. For example, when the 'agree' button was clicked most students felt happy, as well as believing that their response was accepted by the majority of other students. This feature was very similar to Facebook's 'like' button and the 'agree' button in Q&A forums. Thirdly, different buttons clicked by students can promote different reaction patterns. For example, as explained in figure 6.8, the "confuse" button mainly focused on the patterns directed from negotiation such as negotiation to comparison and negotiation to reflection, which is different to the patterns

directed from reflection when the "disagree" button clicked. Moreover, although the conflict induced by reading the comments from others' or by clicking on the 'disagree' button to argue were similar, there were different reactions that students made when experiencing this response to this. Students still insisted upon their own standpoints when reading answers from others which helped students to demonstrate their own perspective during peer explanation, thereby avoiding parroting the views of others. This helped others to understand the students' thinking and own standpoint, leading to a comparative and reflective discussion.

6.6 Limitation

Whilst having discovered and highlighted significant patterns from technology supported discussion learning environment overcome limitations discovered in chapter 4 when compared with significant patterns in face-to-face learning environment, this study has also discovered limitations to do with the students' patterns of behaviour during online supported discussion. As the results demonstrate, significant patterns revealed from the online student-led discussion (see Figure 6.3) is more interactive and lead to different reactions to made students involved in the process of knowledge building process, but there is a loop between reactions of repeated answer, distillation, and summary in the second part of significant pattern diagram. Additional, there are also stronger weight of significant pattern involved with reactions of disagreement to itself (DIS → DIS) and agreement to itself (AGR → AGR).

As discussed in section 6.4.2, the second part of the discussion indicated that students may have already achieved a certain understanding of what they thought was the answer to the question after active discussion. In this stage, teacher should ask further sub question of the question to lead them explore further and avoid higher frequency of reactions of repeated answer emergent. Additional, the significant pattern of disagreement to itself and agreement to itself revealed cumulative mode and disputational model which discussed in Mercer (1996)'s study of three distinct model of children's talk. He highlighted that cumulative model characterised by "agreement, and typically features repetitions, confirmations and elaborations" (Osborne & Patterson, 2012). The model of cumulative could help to support other students' idea but the reaction of repetitions would not help to promote knowledge building process.

The model of disputational talk described interaction as often producing highly competitive, disagreements. He mentioned that from time to time these disagreement escalated, with the children becoming increasingly irritated with each other and engaging in vehement personal criticism(Howe & Mercer, 2007).

6.7 Conclusion

Technology as an intervention provided the opportunity to put students from different years and with different knowledge understanding level together. It not only enabled more students to participate in the student-led discussion, but also led to a greater rate of significant patterns of interaction compared to the face-to-face student-led discussion. Cognitive conflict is regarded as a major factor in promoting different results in the significant patterns. The results showed that reactions of disagreement and questioning were significantly frequently performed since different year group and different knowledge understanding level students participated in the technology supported student-led discussion. These reactions were involved when students were confronted with cognitive dissonance in the process of interaction based on the model of children interactive reactions. The buttons designed in the technology supported discussion and also induced cognitive conflict which promoted students to interactively move between different reactions they performed in the model of cognitive peer interaction. It helped to promote students involved in different reactions to resolve conflict and review their standpoints in order to avoid incorrect information spreading. The model of cognitive conflict was designed to illustrate how exactly what role cognitive conflict would play in the peer interaction to affect students' reactions when involved in interpersonal and intrapersonal processes. This then led students to negotiate with others to compare and contrast the information they found, and reflect on their existing knowledge background. These different reactions that students had helped them to review each other's standpoints and thus achieve a better knowledge understanding.

Based on the data collected from the observation study there were differences of significant patterns between the student-led discussion in a face-to-face learning environment and technology supported learning environment. It also implied that technology as an intervention supported student-led discussion and could induce

cognitive conflict, which promotes students to become involved in the different reactions of comparison, negotiation and reflection. These different reactions could make students review their standpoints and avoid incorrect information spreading. In addition students also had the opportunity to ask questions, share their standpoints and negotiate with others during the student-led discussion compared to their traditional learning strategy. The following chapter evaluates the online student-led discussion learning strategy from both the students' and teachers' perspectives. The result of the evaluation will benefit discussion of how to apply this student-led discussion platform in a way that will be accepted by the teachers, thus not only benefiting the students' learning, but also the teachers' teaching.

7 Chapter Seven

Evaluation of Online Student-led Discussion tool

7.1 Introduction

The aim of this chapter is to evaluate online student-led discussion learning environment based on students and teachers' perspectives. Chapter 6 gave an in-depth picture of how the students took part naturally in the student–led online discussions in the classroom. One of the findings is how the different reactions that students performed related to their cognitive conflict and knowledge building processes. The analysis showed that the online learning environment provided more opportunity than the face to face environment did for students to demonstrate their ideas and become involved in cognitive conflict. This enabled them to achieve potential conceptual change. However, it also led to more questions: how could this online learning environment benefit students' learning from their own perspective and how they thought this online learning environment could be improved? Finally, if this online learning environment could benefit students' learning experience then in what ways could it be applied in the Chinese education system and can student led blended learning be accepted by the Chinese teachers? An interview of students and teachers was therefore undertaken in order to understand students' and teachers' perspectives on the application of an online learning environment.

7.2 Questionnaire for students

7.2.1 Questionnaire for students' learning experience

A questionnaire was developed to indicate students' personal experiences with the online student-led discussion, which is adapted from Asterhan & Eisenmann's (2002) research.. It included ten statements which described five aspects of students' personal experience in discussion (see Appendix IV). The items assessed aspects of participation ("I participated in the discussion", "I had the opportunity to express myself"), interaction ("Students reacted to my contributions", "I reacted to the other students' contribution"), the learning experience ("I felt that I learned new things on the subject", "The discussion caused me to think about the subject",), and motivation ("I was

interested in the topic", "I enjoyed the discussion"). for each item, students were asked to indicate whether they agree or disagree these statements based on their personal experience. values ranged from 1 (strongly disagree) to 5 (strongly agree). Finally, the questionnaire also asked students to answer which year and school they are in. There are total 225 students who attended online student-led discussion in class study answered these questionnaires.

7.3 The interview schedule

7.3.1 Interview for students

The interview was developed in parallel to the questionnaire to expand the understanding of finding from the questionnaire analysis. Sixty three students (aged from 8-11) from the three primary schools A, B and C schools took part in this study. They respondents were randomly selected to evaluate the online student-led discussion tool they used in the experiment and to compare and contrast this with using existing online websites they generally used to solve problems.

The interviews were conducted in the schools' reading rooms. These rooms were quiet and also most students were familiar with them. The hope was that they would feel comfortable during the interview in familiar surroundings. One student and the interviewer sat at the corner of a table. During the interview, the interviewer initially asked some warm up questions about the format of their traditional classroom discussion. Then, they asked the students to evaluate the online discussion tool by pointing out the advantages and disadvantages of it. Finally, the interviewer asked the students to compare and contrast the online discussion tool with the current online tool (Baidu, http://www.baidu.com/) that they mostly used to learn from online.

The data from the interview was transcribed into text and analysed in NViov 10. The data analysis method of thematic analysis was applied to find out themes and carry out coding on the transcripts.

7.3.2 Interview for teachers

The interviews were semi-structured. Nine teachers attended this interview and each one was designed to take 20 minutes. At the beginning of the interview the teachers were told about their rights regarding the study and its purpose. During the interview there was one key theme to be investigated: in their opinion, how could questions asked and comments posted from students benefit the teachers. The first topic was what teachers thought of how the online learning platform was explored and whether they thought this kind of learning environment would benefit their teaching. There were two main points that most teachers highlighted: understanding the level of students' existing knowledge of a topic and reflection on their curriculum design. The following questions explored what they understood to be the degree of student understanding of the topic in general and how they prepared the curriculum before each module they taught. Teachers were also concerned about the limitations of the learning environment. The following questions were asked to explore what steps could be taken in order to overcome the limitations.

Data from the interview was transcribed into text and analysed in NViov 10. Thematic analysis was again applied to discover the themes and carry out the coding of the transcripts.

7.4 Results

7.4.1 Advantage of the online discussion tool: students' perspectives

This section will present students' personal experience with online discussion tool based on the result of questionnaire and interview. The emerging themes presented from the interview data set from the students are similar to the five aspects of questionnaire. These results helped shed light on how the tool affect their personal learning experience (see Table 7.1).

Theme	Subtheme	Frequency	Questionnaire aspects	Mean	SD
Participation		30	Participation		
	Opportunity to ask	7	Opportunity to express myself	4.12	1.006
	Opportunity for discussion and sharing	23	Participant in discussion	4.25	0.862
Interaction		22	Interaction		
	Response from others	13	Reacted from others	3.87	0.954
	Response to others	9	Reacted to others	4.13	0.976
Learning new things		70	Learning new things	4.21	1.012
	Help others learn	11			
	Correction	11			
	Learn from others	59	Cause to think	4.19	0.970
	Compare and contrast	11			
	Correction	7			
	Negotiation	13			
	New knowledge	28			
			Interest	3.99	1.011
			Enjoyment	3.90	1.010

Table 7.1 Advantages of the online learning tool from interview and questionnaire results from students

7.4.1.1 Participation

As result of interview and questionnaire, both identified that this online student-led discussion tool provide the opportunity for students to express themselves and also provide the opportunity for them to join the discussion (see Table 7.1).

7.4.1.2 Interaction

During the discussion, they also interact with other students through reacted from other students' contribution and reacted to other students' contribution.

7.4.1.3 Learning new things

The advantage of the online learning tool that the children mentioned most from interview was learning new things, which also get higher mean value from the questionnaire. In the interview results, they mainly described this from two different perspectives**:** helping others to learn and learning from others. What was found was a reciprocal process for children to interact with others. As described in the interaction perspective (see Section 7.4.1.2) children not only got responses from others, but also responded to others. In this two-way interaction the children concluded that they learned from this process. From the perspective of helping others learn there were three parts that they described as beneficial to their learning experience.

"Correction" means that the children thought that their explanation and answer helped others to get the correct answer.

During the interview most children pointed out that they had learned from others. They believed the answers provided by others could help them to compare their own answers to others and reflect on their understanding. They also thought that the answers provided by others helped them to correct their own answers. After reflecting on their own answers they could then find the differences between their understanding and the answers of other students and use this to reach the correct answer, which is similar to the cause to think aspect which highlighted in the questionnaire. Negotiation was another benefit they said they obtained from using the online learning environment. They said they met with conflicting explanations and answers from others. However, the process of negotiation helped them to learn more from the others. Most children mentioned that they learned new knowledge from others but without providing additional explanations of how they learned this new knowledge.

7.4.2 Students' perspective of the disadvantages of the online discussion tool

A well as the advantages of the online learning environment the children also pointed out some of its limitations. There were four main themes that they suggested (see Table 7.2). Firstly, they suggested providing the best answer from the answers provided by

the children. Secondly, children suggested having more topics involved in the discussion (only one topic was used involved in the experiment). Thirdly, the role of the teacher attending the online learning environment was debatable based on the results of interview. Finally, children pointed out that other children provided some meaningless data.

Theme	Frequency
No need to improve	17
Provide best answer	10
More topics involved	5
The role of teacher	3
Meaningless data	9

Table 7.2 Suggestions from interview results to improve the online learning tool

7.4.2.1 Relationship between position of best answer and cognitive reflection

During the interviews, some children pointed out that the best answer should be given after the discussion. The following question was structured to ask where the best answer should be placed. A small number of children who had used a similar online discussion websites (*Baidu Know*) felt that the best place for the answer was at the top of the answers. However, most children would prefer the best answer only to appear at the end of the discussion. The reasons that children used to support why they believed the best answer should appear at the end of discussion were related to their own reflections. Reasons suggested by the students for placing the answers at the end of the discussion were:

"The best answer should be posted at the end of the discussion because all the information about the answers posted by ourselves, and the evaluation of the answer provided by others can help us to become involved in the reflective process. Then we can compare and contrast these answers to the best answer."

"It is better to post the best answer at the end of the discussion. It can help us to look at other students' answers first and then compare the best answer. We can then understand what is wrong and what is better."

"I hope the best answer can be put at the end of the discussion. If the best answer is at the top of the discussion, most children will copy that best answer rather than reading the other children's answers and evaluation."

"The summary from the teacher would be best put at the end of the discussion because I will have my own summary after reading the other children's comments. In this situation, I can compare my own summary to the teachers' summary which could help me to understand where the differences."

The reflective process and making comparisons were mentioned many times during the interviews by the students to support their claim to put the best answer towards the end of discussion. The students believed the reflecting process would help them to understand how other children answered the questions and also how other children evaluated the comments rather than simply providing the best answer to them. The process of being able to compare and contrast the best answer with the answers provided by others was viewed as the most important factor for them in gaining a learning experience.

However, some children wanted to put the best answer at the top of the discussion. The reason for this being that they believed it would be better to see the summary rather than looking for the best answer at the end of discussion.

7.4.2.2 The role of the teacher in the online learning environment

During the interview, children also suggested what the role of the teacher should be in the online learning discussion. However, the role of the teacher in the online learning environment was also debatable based upon the results of the children's interview. One group of children wanted the teacher join in the discussion to help solve conflicts, provide best answers or to summarise points made. On the other hand, the children didn't want the teacher to join the online learning environment. The main reason of refusing to have a teacher present involved issues of authority.

"If the teacher joined the discussion, some children would say that my answer is the same as the the teacher's so your answer is incorrect."

"If the teacher joined in the discussion, sometimes we can't think by ourselves."

"If an authoritative person joined the discussion, it would affect our communication and deny our opinions."

Based on the interview transcript most children were afraid that the presence of a teacher would affect their communication and children would compare their answers to the teachers' and reduce their motivation to communicate online.

On the other hand, some children wanted the teacher to join the discussion only when they needed a teacher to provide the summary or best answer. Although some students wanted a teacher to participate in the discussion, they only wanted the teacher to help to solve any conflicts they might confront and to choose the best answer for them to in order to help them to understand the information better. They also did not want the teacher to participate directly in the discussion. The student-led discussion was still required by most students rather than a teacher-led discussion.

"The way for the teacher to join in the discussion is to only provide the best answer at the end of the discussion when the children can't answer it or have answered the question incorrectly."

"The teacher can give us some advice rather than directly giving us the answer."

"I think that there should be a person to help us choose the best answer, such as a teacher."

7.4.3 Child friendly and understandable online learning tool for children

In order to understand the students' learning experience with the newly designed student-led online discussion platform, the aim of interview was to ask students to compare the existing online platform that the children used to search for solutions and learning that is produced by Baidu (www.baidu.com) and Baidu Know

(https://zhidao.baidu.com/). Baidu Know is a Community-based Question-Answering (CQA) site that helps people to answer many questions. Feedback from the students showed most preferred to use this website to find answers to their questions. Users can post various questions to find the best answers provided by others. However, this website is not designed especially for children and many different users post various answers on this website. In order to understand the students' learning experience after they used the online student-led discussion tool they were asked to compare and contrast this student-led discussion tool with the Baidu Know online learning tool.

Table 7.3 shows the reported advantages and disadvantages of each online learning platform as highlighted in the students' responses. Firstly, students mentioned that the target user from each online learning tool was different. They pointed out that Baidu Know is mostly used by adults. There are many different answers posted by adults, which are very difficult for them to understand. However, the student-led online discussion tool is especially designed for children. All answers posted by the children were by children of a similar age to one another. The content posted for and by them would, therefore, be easier for them to understand.

Current tool		Baidu	
Advantages	Disadvantages	Advantages	Disadvantages
Kids use only Understandable Actively sharing and asking Thinking process involved Feedback and evaluation from similar age group	Wrong answers given	Expert involved therefore answers more correct	Adult use only Passively receive answer directly Lack of evaluation Lack of thinking process Massive and abstruse content

Table 7.3 Categories of results from the interview

"There are many people who posted different answers in the Baidu Zhidao, especially some experts also posted some answers there. But I cannot understand it. "

"In this website, the answers are all posted by our students which was based on the perspective of our own students' view. It was easier to understand. "

Secondly, the way they learn the information from the online learning tool is different. Most children mentioned that they passively received the answer via the Baidu Know website. The reason why they felt they were passively learning was because that there was less opportunity for them interact with others. There were several examples given from the interview as to why they felt this.

"Baidu Know website will give you the answer directly, but this website has different opinions from different students who are involved in the thinking process."

"You can directly get the answer when you use Baidu website to search the question. This website can search, ask question, provide help to others' questions and also can get the help from others."

"The difference between Baidu website to this website is that you can post your own idea and opinions in this website. You need to think about other children's opinions and feedback. Baidu website gives your answer directly from others. "

Thirdly, the major point that children discussed about the differences between these two websites was the different learning experience. In the student-led online discussion platform the children more actively joined in the discussion and asked questions compared to passively receiving the answers in the Baidu Know website. There was greater emphasis on reflection due to the thinking process. Most children pointed out that the disadvantages of the Baidu Know website were due to its lack of evaluation and thinking processes. As mentioned earlier, the answers posted were mostly from adults without any explanation as to why they posted this answer. Students normally read these answers passively without thinking how the answer had been constructed. Also, answers posted by adult users were difficult for students to understand. The only thing that students know is that these answers are possibly good answers posted by an expert. Most students will memorise the answers, but cannot reflect and compare their existing knowledge to this information. In contrast to Baidu Know the online student-led discussion tool provided the students with an opportunity to ask questions and share their ideas with others. More importantly, they were able to interact with other users of a similar age to understand the answers they posted. Additionally, most students posted their answers based upon their own ideas and negotiated with others if they received

different ideas. It helped students to see how the answer was generated and to read the feedback and evaluation from other students. It would help them to become involved in the thinking and knowledge construction process.

7.4.4 Teachers' evaluation of the online student-led discussion tool

This section will present emerging themes from the teacher interview data set. Four themes were identified by the review regarding the online learning environment for students (see Figure 7.1). Four main themes emerged through the thematic analysis. These declarations may shed light on the teachers' perspectives of how the student-led online learning platform affects their teaching and their students. Although the four themes were treated as discrete, they are in practice more interdependent.

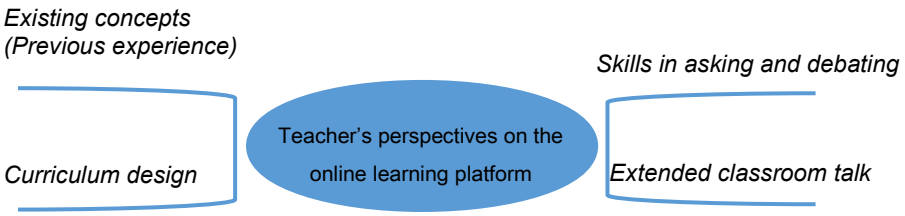


Figure 7.1 The major themes elicited from the result of interview with teachers

7.4.4.1 Existing concepts (previous experience)

The main point that teachers highlighted was the revealing of students' existing concepts or prior experience of a topic from the data generated in the student-led online discussion environment. The role of previous experience is very important to the teachers. During the interviews all the teachers mentioned that if they know the degree of the students' current level of understanding it can contribute towards their teaching. "*We understand their levels of existing prior experience then we'd know how to teach correspondingly.*"

"This is quite helpful. It fully shows students' prior experience, their original status and the accuracy of their prior experience. It helps us to understand students' current degree of knowledge"

However, teachers also pointed out the limitations in knowing each student's current level of understanding by reading through each student's comments. *"After I read some*

students' comments, it is good for us to know students' prior experience by reviewing their answers. But we are very busy and we did not have much time to read each student's answer."

The following questions were designed to explore how teachers assess the level of students' understanding in the traditional way and discusses how they can overcome the limitations they pointed out before (see Figure 7.2).

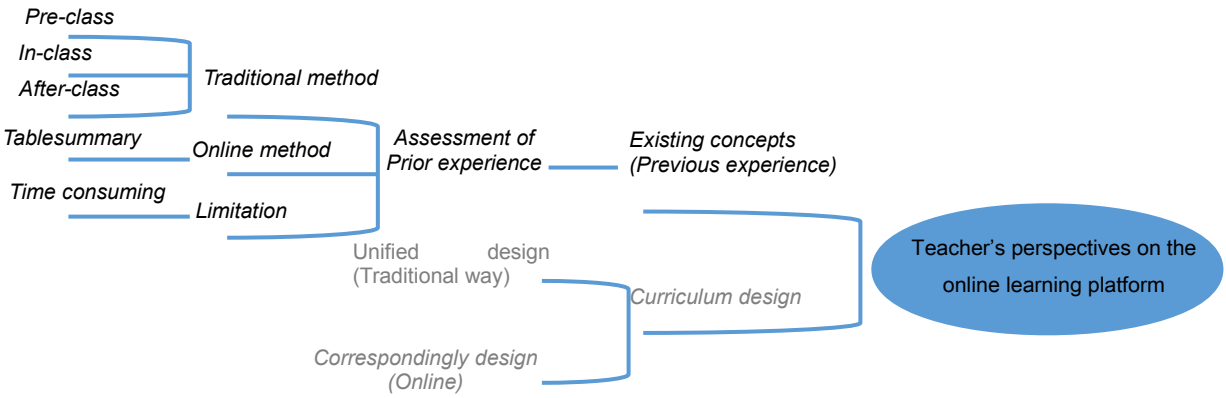


Figure 7.2 The following categories elicited in existing concepts (prior experience) and curriculum design categories

7.4.4.1.1 Assessment of previous experience to reveal the degree of students' current understanding of the topic

As discussed before, most teachers pointed out that this kind of student-led online discussion environment could clearly show the students' previous experience. The role of previous experience plays a very important role in teaching and learning. Brown, A. L., & Cocking, (2000) pointed out that "all learning involves transfer from pervious experiences". Students normally use the previous knowledge to structure new understandings. However, the different previous experiences that students have would cause problems when students learn new knowledge (as discussed in Chapter 2 Section 2.3.2.1). Students may prefer to use their own experiences to illustrate new knowledge rather than examples provided by a teacher (Driver, R., Guesne, E., & Tiberghien, 1985). Misconceptions are easily made as a result of misunderstandings. From the teachers' perspective, it is very important to assess students' levels of pevious experience to define whether they have any misconceptions of the topic.

7.4.4.1.1.1 The Traditional way to understand students' comprehension of each topic in school lifecycle

Based on the interview results, there were three main ways that teachers adopted to assess the level of students' understanding of a specific topic in school: pre-class, in-class and after-class.

"In general, we will have a conversation before class for some specific student. we can ask students "what do you know about this?" when we learn a course, for example, when we learn the unit of the earth and the universe, we can bring out two pictures of the earth and the universe, and two large pieces of white paper. then put down "what do I know about the earth's movement?" on one paper, I will ask the students to write down the answer they already know and on the other paper to write down the knowledge they did not know but want to know. It can help to learn about the students' prior understanding of this topic."

Some teachers pointed out that they will assess whether a student can understand this topic by interacting with students. For example, eye contact and asking questions during the class.

"There are many different ways to know. Firstly, I can look at the students' performance in the classroom, by looking at his facial expressions and eyes. Secondly, homework and we have unit tests once a month."

Although there are many different ways to test students' previous experience, the teachers did not have much time to actually assess this knowledge. The most common way that teachers understood and gauge his knowledge and experience this was to apply a test after class.

7.4.4.1.1.2 Limitations on teachers defining previous experience for all students

A typical response when asked about knowing a student's previous experience before class was: "It is a time consuming job to define students' prior experience before each class." Most teachers argued that they were very busy preparing modules, rating homework and teaching. On average, teachers in China would teach five classes per day, they also need to prepare tools that are required to allow students to conduct

experiments in class. Sometimes, they would also need to have a conversation with students whose homework wasn't successfully handled in order to help them to understand the subject better. In total, this was estimated to take the teacher about six hours a day to carry out this work.

They agreed that previous experience and misconceptions would affect the students' learning ability. However, it is very difficult for them to talk with each student individually or to look at each student's answers to discern their level of understanding. So they would only apply a standard test to examine the students' understanding after teaching rather than test their previous experience and reflect upon their curriculum design.

7.4.4.1.1.3 Online methods to generate a summary for teachers to review students' understanding

Teachers agreed that data generated from the student-led online discussion reflected the students' level of understanding. Based on the issues relating to the consumption of time, the teachers made a suggestion that the online learning platform could summarise the data posted by the students and present this information to the teachers. This could help to save time for the teacher from having to look through each student's comments and instead allow them to understand the overview of the group of students' level of understanding.

"It would be better if it were a form, summarising different answers. For example, the questions like "why is there the alteration of day and night?" students may come up with various reasons (Reason1, Reason2, Reason 3…). Some might be totally irrelevant; some are exactly correct; some are partially correct. If we could see a summary, it would be very helpful. "

"It would be great if the form can present a summary, showing every aspect, every knowledge point, to what extent they answer, how many students agree and disagree. It also would be better to show the students' name as well. If there are only a few mistakes, then I just need to check who raised them. If there are only one or two giving incorrect answers, I might just talk to them privately; if there are many students who are incorrect,

I might choose to deal with it in class. The statistical results would significantly increase efficiency. ”

There is a very strong relationship between the level of understanding and curriculum design. Based on the results of the interview, existing concepts and curriculum design are the main points that teachers mentioned many times. The teachers wanted to understand the students' existing concepts in order to reflect on their curriculum design.

7.4.4.2 Curriculum design

As described in Chapter 2, the main type of classroom talk in China is presentational talk. Teachers will prepare the class based on the guidelines of the national curriculum and deliver this information to the students. Students would sit down and take notes on the information being delivered to them by the teachers.

7.4.4.2.1 Unified design of the curriculum for all students

Chinese teachers are very busy every day. They have to design the curriculum in advance such as outside of their set working hours or during their holiday. They will design the curriculum based on their own experience of teaching students before. Then they will change the curriculum design after teaching some classes. For example, most teachers mentioned that "we will teach many classes for the same topic. If I do not feel good when I teach the first class, I will change the curriculum design based on the reaction of the students during the class. For example, sometimes I will use totally different ways in which to teach the same topic for different classes based on the students' mode of thinking. If class A's students' level of understanding is lower than others, I will explain more during the class. If class B's students' level of understanding is better, I will allow them to explain more. If discipline level in some class is better I will give them more opportunities to explore when they do experiments in class. However, if the class discipline is not good I will set more limitations for the students when they do the experiment in class." Therefore, the common way for teachers to design their curriculum is to base it first of all on their own experience, and then change it based on the reaction of the students.

7.4.4.2.2 Tailoring design of the curriculum for students

The main point that most teachers mentioned was that data generated from the student–led online discussion platform could reflect on the students' prior experience, which also would help them to design the curriculum correspondingly to match the individual's previous experience. Some example comments are as follows:

"Based on students' existing previous experience, it would help us to know how to teach correspondingly."

"Based on the results of the level of students' understanding, it helps us to define what knowledge the students were clear about and what was obvious to everybody, so we don't need to teach them again, saving the time for unclear questions."

" … it is important for adjusting the classroom teaching pace. For example, in the lesson about the morphology of Plants and Organisms and their adaptation to environment, if we know that students have understood the concept quite well, we will design some other questions. We may ask them to look up some information about this."

The teachers pointed out that it would be of benefit to them to design the curriculum relative to the students' level of understanding and also that they could understand the students' misconceptions which is very important for the teachers to detect in their classes.

7.4.4.3 Asking and argumentation skills improved in the student-led discussion

The third theme that emerged from the results of teachers' interviews was that of asking and argumentation skills. The teachers agreed that this kind of student–led discussion would be of benefit to the students to improve these skills. Two example quotations illustrating this are given below:

"These multifarious questions that are asked by students are definitely beneficial. The fact that students are encouraged to bring up questions can help to foster their abilities of questioning. Additionally, the student-led discussion allows them to show their ideas

and debate with others. However, it is hardly possible for teachers to answer all of the questions, but teachers can stimulate students' interest through these questions. The most critical part is whether the students are able to come up with a solution/answer by themselves. Then through combining knowledge learned in class with the question, it would be nice."

"This kind of student-led discussion is good for our students to join the debate. We agreed this discussion is of benefit to our students. However, it is very hard for us to adopt this kind of discussion in the classroom talk. There is a lot of information we need to deliver to the student and it will disturb our teaching pace by allowing students to ask questions and discuss these points during class."

The teachers also pointed out the limitations on them being able to apply this kind of discussion in the class although they all agreed this kind of discussion was of benefit to their students. Firstly, the fact that students are asking question in the class would disturb the pace of class that the teacher has planned. The teacher would normally ask their students to ask questions outside of class time if they have any queries. For example:

"I usually would let students ask questions out of class time if they have any questions. Questions they asked would influence the process of the class. I already design the curriculum and knowledge I have to deliver to students within 40 minutes. Discussion and questions allowed from students would easily run out of control."

In China, there is very strict requirement for teachers to deliver their subject designed from the national curriculum to students within one semester. The teacher would design the curriculum to deliver this information on time without any opportunities for students to discuss or ask questions in class. However, out of class time, only students who have good grades would ask their teacher questions. It is very rare for students who don't have good grades to ask such questions. Secondly, some questions asked by students may not be relevant to the topic that the teacher has in the class. The following quote from a teacher illustrates this: "Students in the lower year would have a lot of questions to ask if you allowed them to ask the questions in the class, but higher year students may not prefer to ask any questions or answer the questions." However, the questions

they asked may not be very close to the topic that the teacher has taught in the class or may be in an area of study that the teacher would cover later. The following quote illustrates this: *"I usually will let students ask questions after the class if they have any questions. The questions they ask usually cover what I will teach later or the information is not very relevant to the topic. If I ask them to ask the questions out of class time it can help to reduce half the questions they want to ask. "*

7.4.4.4 Online learning platform as another opportunity to extend classroom talk

The limited opportunities for teachers to discuss with students the questions that they are curious about that have been discussed in the class topic were highlighted above. However, the skill of asking questions and argumentation is a very important one for students to obtain. Teachers regard this kind of student–led discussion as another opportunity for students to extend classroom talk outside of school time. They pointed out that the questions generated by students also reveal the knowledge they did not understand from the class:

"It has the relationship between the questions and knowledge they did not completely understand. Because there are always some students listening while some others are not in the class. And another fact is that some knowledge comes from memory while some others from life experience. Some students have been to Hainan, so they know the plants in Hainan are luxuriant and their leaves are so big; some have been to the desert, so they saw that grasses there are so short and little. People with experience would know that plants are different in different environments. Knowledge coming from books can easily be forgotten and we are not able to put it into an experiment. Another opportunity for them to discuss and ask questions would be a benefit for them to remember and retrieve the information and facilitate understanding."

"The time for each class is limited so that some knowledge is supposed to be learned at this stage while some others would be put aside for later learning."

Teachers argued that the time for each class is too limited for them to be able to explain all information points in the class. The example or knowledge they discussed may not be explained very clearly, which in turn leads to students having questions. Some

students may come to ask the teacher out of class time, but some students may ignore the opportunity.

7.5 Discussion

7.5.1 Participating in student-led discussions is an opportunity to ask and share

The opportunity provided for Chinese students to ask and share with others is the significant characteristic of online student-led discussion highlighted from the students' perspectives. As explained from the literature (Chapter 2 in Section 2.2.2), the lecture based teaching strategy influences the type of classroom discussion in the Chinese classroom. It is a rare opportunity for Chinese students to ask questions in the classroom. The only opportunity for Chinese students to join in classroom discussions is in a teacher-led discussion. In such situations students were asked to provide answers to questions designed by their teacher to test whether the students understood the topic clearly or not. These questions are mainly closed questions. Additionally, the teachers would expect the students to respond to their questions with a response the teachers would be expecting due to the nature of their closed questions (Fisher, 2008). A new approach, such as the current student-led discussion platform that was used with the Chinese students, would provide them with an opportunity to interact with others and to ask questions they were curious to explore with others. It also proved some researchers' arguments that Chinese students actually have strong desires to participate in classroom activities and have a preference for a more student-led style of teaching. It argues against Zhao's (2008) findings that Chinese students prefer passive teaching methods rather than participative teaching methods. As supported by the outcomes of the interviews with Chinese students, they clearly stated that they liked this online student-led discussion tool as it provided an opportunity for them to ask and share questions with others rather than with Baidu Know in which they can only passively read the answers posted by an 'expert' without interacting and negotiating. Throughout their interviews the students also drew attention to the reflection and thinking processes that this online student-led discussion tool enabled them to participate in. The following section will explain how student-led discussions affected their learning experience when they interacted with others involved in the knowledge construction process.

7.5.2 The learning experience from student-led discussion is a reflection process

Both the reflection and thinking processes received a high level of discussion amongst the students during their interviews. Firstly, based on the results of the advantages of the online student-led discussion, learning new information was categorised as an emerging theme. Learning from others was especially highlighted by students as the theme of learning new knowledge by the process of comparing and contrasting their answers with others students' responses and negotiating with others relating to the merits of the responses. The results of discussion on how to improve the online discussion tool showed the students recommending the best answer be placed at the end of the discussion. This also showed that students were concerned about the reflection process rather than just finding the correct answer. It also supported the results of the interview which asked students to compare Baidu Know with the current online discussion tool. Students pointed out that Baidu Know did not allow them to review the answers generated by students from a similar age group. The student-led online discussion tool could allow students from similar ages to interact with one another and help to see how they generated their answers. Students preferred being involved the process of knowledge construction and to understand how other students in their similar age group constructed their answers. All the points that the students highlighted from the results of the interview were similar, which would suggest that the Chinese students were less concerned about answering the question correctly than they were with finding out how the answer was created and the process by which they came to that conclusion. This is a surprising result when compared with the current literature. Based on the literature, the main learning strategy for Chinese students is to accept the teaching delivered to them by their teacher and for them to memorise this information without very much thought and consideration. However, most Chinese students showed that they preferred to understand how other similar age students thought about these questions and develop their answers. In addition, they also enjoyed negotiating with others and getting feedback from others. In fact, this process in which students compare and contrast the answers posted by others, and negotiating with others when they have different opinions, reflecting on their existing understanding and scaffolding them to achieve greater knowledge of the subject.

Bruner (1986) argues that direct instruction or direct answers provided to children to reach the potential of their capabilities is not due to the children themselves. It is more likely that children loan adult's consciousness that gets through the zone of proximal development. The appropriate instruction suggested by researchers should be providing more possibilities of problem solving solutions for children during the peer scaffolding process. It can help to encourage children to clarify different possibilities and reach conclusions by themselves. Based on the reflection and thinking process that Chinese students mentioned, they are in the process of peer scaffolding during the peer interaction. Reading the answers posted from other similar age students helps them to review different possibilities of the answer to the questions. Comparing other students' answers to their own answer could help them to reflect on their understanding to clarify all possibilities and, in the end, reach a conclusion by themselves. It could encourage them to negotiate with others to find the best answer to the question rather than simply transferring information or being told the answers by teacher or others to themselves.

7.5.3 Implications from the teachers' perspective

The skills of inquiry and argumentation play an important role in science education. It is widely agreed by researchers and teachers that science is essentially a question driven, open ended process and that students must have personal experience with scientific inquiry to understand this fundamental aspect of science (Linn, Songer, & Eylon, 1996; NRC, 1996; Project, 2061). Most teachers agreed that there was value provided by technology to support inquiry based learning in the student-led learning style. Although there is a large amount of research which focuses on how to change classroom talk to become more like exploratory talk to motivate more students to ask questions and discuss with each other, there is still a big challenge for adopting such discussion in Chinese classrooms. The main point discussed from the interviews to explain the limitations of advocating student-led discussion in the Chinese classroom is that teachers are expected to follow the regulations designed by the Ministry of Education of the P.R.C. closely and to accomplish the content within limited class time (Cheng, 2010). Also there are, on average, six classes per day that each teacher is allowed to teach. In order to deliver the content on time and make sure that all six classes are taught as per the regulations it is rare for Chinese teachers to be able to provide an opportunity

for students to discuss any issues in class. Increasing autonomy for students to ask questions and hold discussions would mean an increase in the risk that teachers would lose control of the class. Teachers also pointed out that the questions that students may ask may not be relevant to the topic they are being taught or the questions they might ask could be about a topic that the teacher is due to teach later in the term. This is another reason why teachers ask that students to pose questions out of class time, thus reducing the risk of damaging vital teaching time. However, this also reduces the opportunity and motivation for students to ask questions.

The reasons provided by teachers have demonstrated that the lecture delivered by an authority figure is still the central vehicle for transmitting knowledge in the Chinese educational system. However, the feedback from teachers also showed that they agreed that an online student-led discussion platform would not only provide the opportunity for Chinese students to improve their asking and argumentation skills (which is lacking from the current Chinese teaching strategy), but would also provide the opportunity to extend classroom talk which is not finished within limited class time. Based on the benefits that these online student-led discussion tools can provide an application for its tool will be to enhance teaching and learning. Teachers pointed out that there are three main challenges that they faced. Firstly, it is time consuming work for them to know the preconceptions and misconceptions that students have. There are around 200 students that each Chinese teacher needs to teach every day. Secondly, Chinese teachers design the curriculum for Chinese students based on their own experience. It is difficult for them tailoring the design of the curriculum based on each student's preconceptions. Most Chinese teachers initially design the curriculum during the holiday period and based on their own experiences. They will then change the curriculum based on the students' reaction. However, each student's level of understanding and preconception is different, a unified curriculum design may not suitable for all students. Chinese teachers highlighted that they will slightly change their curriculum based on the students' thinking skills and level of understanding. Finally, they agreed that many students try to ask questions about the topics being studied and also that there is a lack of opportunity for students to interact with each other and ask questions in class.

Based on the challenge that Chinese teachers faced and the limitations of teaching and learning strategy designed in the Chinese classroom, the extended functions were

designed in the existing teacher management system (see figure 7.3), which were highlighted in the dotted line. Based on this system, Chinese teachers can apply this online student-led discussion tool to **create new task** to allow the students to answer questions they designed specifically for the topic they would teach in the next month. Based on the students' questions and discussion, the function of **visualization of students' contribution** would help teachers to get **summary of overall view of students' current understanding** of this topic. Additional, teacher also can **check and search specific detail information** of students' contribution. This information can help teachers to design the curriculum based on the students' preconception of topic. Then based on the students' existing knowledge and misconception of the subject, they will combine it and deliver to the Chinese students in the classroom talk. In order the evaluate how this new approach would affect students' learning experience and teachers' teaching experience, the next chapter will examine whether student-led blended learning can be accepted by teachers in the Chinese classroom.

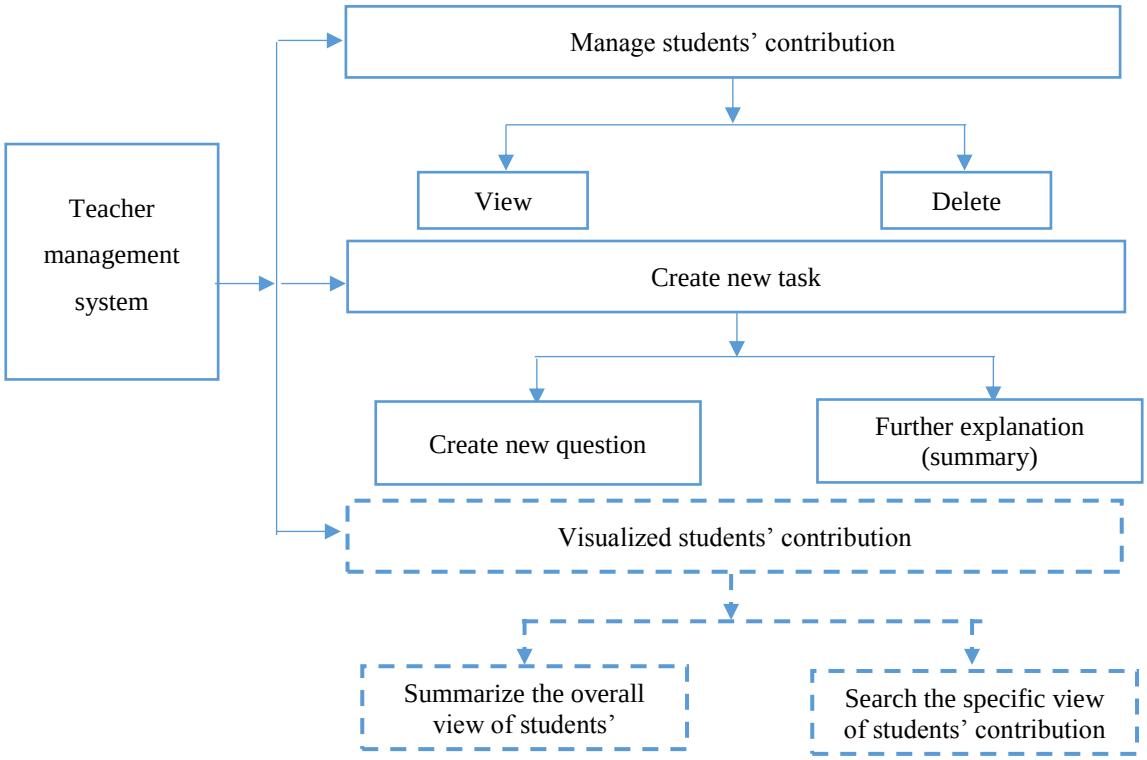


Figure 7.3 extended functions in the existing teacher management system

7.6 Conclusion

This chapter has examined the evaluation of online student-led discussion learning environment based on students and teachers' perspectives. Based on the students' perspectives, this online student-led discussion learning environment firstly provided opportunity for them to ask questions and share their own viewpoints with others rather than with Baidu Know in which they can only passively read the answers posted by an 'expert' without interacting and negotiating. Secondly, during the interaction with others, it helps students to learn new knowledge by the process of comparing and contrasting their answers with others and negotiating with others relating to the merits of the responses. This process did not present "correct" answer to them directly, instead, reading the answers posted from other similar age students helps them to review different possibilities of the answer to the question, which help them to involve in the reflection process to reach a conclusion by themselves. However, limitations of this online student-led discussion tool also been discussed.

Based on the teachers' perspectives, it implied that the contributions that students made in this online student-led discussion could shed light on their existing knowledge understanding level, which could help teachers to detect students' existing knowledge understanding level. These feedbacks from the system could help to tailor design of the curriculum for students. Additional, teachers also agreed that this online student-led discussion could help to practice students' asking and argumentation skills and overcome existing Chinese education system's limitation such as limited time for classroom talk. The results of teachers' interview implied extend functions design of this online student-led discussion system which can be applied as a tool not only support students' learning but also benefit teachers' teaching. In the next chapter, it will explore how this functions extended system could be applied in Chinese education system and be accepted by Chinese teachers.

8 Chapter Eight

Application of the Online Student-led Discussion Tool

8.1 Introduction

The online student-led discussion platform was shown to provide the opportunity for Chinese students to ask and share their ideas with others. Cognitive conflict confronted by the Chinese students also led them to have different reactions allowing them to promote knowledge construction with others. Student-led discussion platforms are regarded as a peer scaffolding as they provide different possibilities of providing answer for students and encourage them to compare various possibilities of answers whilst also reflecting upon their understanding to reach a conclusion by themselves.

After evaluating the unique background of the Chinese education system, the Chinese teachers agreed with the value that the online student-led discussion provided to students and themselves. However, most teachers confirmed that the lecture, delivered by an authority figure, is still the central vehicle for transmitting knowledge in a Chinese education background. There are many challenges that teachers will confront if they adopt a student-led discussion as the central role for transmitting knowledge. Based upon the results from the interview with teachers, the implication was that the online student-led discussion platform can help to reveal the students' current existing understanding of the subject which also can benefit the teachers when tailoring curriculum design for their students.

In order to explore how this online tool could be applied into a teaching strategy which would suit the current Chinese education background in this chapter will present an evaluation of the application tool both from the teacher and students' perspectives.

8.2 Research questions

According to the research purpose described in the introduction, the research questions to answer are:
RQ3.3: Can student-led discussion as supportive tool be accepted by Chinese teachers within the Chinese education system?

8.3 Research design

8.3.1 Procedures

8.3.1.1 Application of an online student-led discussion tool outside of school time

The participants in this study are similar to the study conducted in the face-to-face discussion and online student-led synchronous discussion from school A, B, and C. However, one of the classes from school B needs to attend the national competition, therefore it was not possible to arrange the time for this class to attend the study. This was the year 4 class from school B. Three hundred and forty three students joined the out of school study. Before the study document highlighting the requirements of this study were given to each student (attached in Appendix III). There are four main points explained in the document. The ethical issues about the study were laid out; these will be explained in Section 8.3.2. The next section explained the procedures of the study. This included a brief explanation of the aims of this study as well as providing the website address for students to login to the program out of school time. Each student's unique username and password were also attached for them. Instructions for how to access the website were provided. Although most participants had used the website before it was possible that some of the students might still have needed help to tell them how to use the website. Two further sections were provided. One was called the Task section. In this section, questions were posted by a science teacher and were designed to highlight which school and year the students were from and, therefore, which students should answer these questions. Based on the different levels of science model teaching from different schools and different years, there were a total 15 questions designed by the science teachers. During the study, students from different years and schools all had a right to post their answers to each question no matter whether this was in the Homework Session or the Question and Answer (Q&A) Session. The document requested that students check the questions from the Homework Session initially and then they could move on to assess the Question and Answer (Q&A) Session to ask any questions related to science not only restricted to the subject being studied which was about how plants grow.

The students' only opportunity to access the website was over the weekend. Over a month the data from use of the on-line tool were collected to a database and at the end of this period this was summarised. The teachers then redesigned their curriculum based on the results of the students' discussions on the website. In face-to-face classroom sessions the teachers explained the main misconceptions that students had expressed.

8.3.1.2 Interview on students' perception of application as the tool in learning

After the classroom session interviews were conducted with students to evaluate the application of this online student-led discussion platform as a tool to provide them with an opportunity to discuss the science topic before it was taught to them in class. The method applied was the use of focus groups. The main procedure was similar to the way in which the previous interviews had been conducted. In total 48 students attended the focus group interviews. As in the previous experiments the interviews were conducted in the schools' reading rooms which were quiet and familiar for most students. It was hoped that they would feel comfortable during the interview in the familiar location. The interviewer sat in the middle of the students at the corner of a table. Before starting the interview, the children had repeated to them the ethical issues that were explained in the section relating to ethical issues (Section8.3.2). At the beginning of the interview, warm up questions were designed to understand how Chinese students normally prepare for lessons. Then students were asked to compare and contrast the way they preview their topic before the class when using the traditional method and when using the online supported method. Additionally, students also were asked to do provide a self-report about the learning experience of using the blended learning environment.

8.3.1.3 Interview on teachers' perception of the application of the tool in teaching

The main purpose of the teacher interviews was to firstly gain feedback from the teachers to review whether the results of using this application showed the benefit to them that they expected. The teachers had highlighted in the previous interview that the overview of students' previous experience of a topic is important for them to try to detect whether the students had misconceptions of the topic and what percentage of students already knew the topic (in Chapter 7). Based on teachers, it also can explore whether teacher can accept this application which not only provide the opportunity for

students to build argumentation and problem solving skills but also benefit on teacher to tailoring student' knowledge understanding.

8.3.2 Ethical issues

The consent form in Chinese is shown in Appendix II. Consent forms were sent separately to the schools' head teachers. With their agreement, they helped to explain the study to the parents of all students approached to participate in the study and also secure agreement from them, then the children were provided with documents detailing the process of the study.

In each document given to the students it stressed that this study will record students' comments posted in the website but that the names of all students taking part would remain anonymous. All data collected from the study would remain strictly confidential, which means that only the researcher, would be able to review it and that any comments or questions quoted as part of the research and findings would also remain anonymous. The document stated that, if at any time during the study, the student wished to delete the questions they had posted or comments they had contributed towards, then they were free to do it. The researcher's contact information such as name and email was provided so that students knew who to contact if they wanted to withdraw any information.

The same as the ethical issues were mentioned in Section 6.2.4 in Chapter 6. In order to secure the children's online learning environment only participants were able to log on to the learning environment. Without providing a username and password other people were unable to log into the website. This also helped to ensure that no other users were able to access the website without permission. All users' names were anonymised on this website and no children were identifiable from the website.

Before starting the interview the children were briefed as follows: "Thanks for helping me. I will ask some questions about your experience with the experiment you have just done. In order to review our conversation, I will audio record our discussion. Are you OK with this?" the interviewer then waited for the children's feedback. All the children agreed with and were comfortable with the audio recording. After the children replied the interviewer continued, saying that "our talk will be totally confidential, which means

only I will listen to it and if I quote your answers, it will be anonymous. Also, if at any time during the interview you want to quit or skip a question, feel free to do it." In fact, no child asked to leave or skip any question. At the end of interview, the interviewer gave their contact details i.e. name and email address to the children, and the children were told to contact the interviewer if they needed to.

8.4 Results

8.4.1 Participation

In total 343 students who took part in this study. However, only 268 students attended the study out of class time. Compared to the average of 34 students per class who joined the online synchronous student-led discussion, there was an average of 29 students per class who joined the online asynchronous student-led discussion. This number was less than the average number of students in the synchronous online discussion study but more than the average number of students in the face-to-face discussion. Based on the figures shown in Table 8.1, there was a difference between the number of students who gave their ideas in the classroom based online discussion and the out of school time discussion. Some students did not post their ideas during the discussion but did assess the website and read the questions and comments by clicking the reviewing buttons.

		N	No.Participants	Percentage%	No.Replies	MAX	MEAN	SD
3		40	33(16)	82.5(39.0)	97(51)	13	2.43	3.281
4	School A	41	29 (35)	70.7 (85.4)	132(226)	18	3.22(5.51)	4.222
5		40	36(26)	90.0 (66.7)	89(94)	7	2.28(2.35)	1.669
3		43	18 (33)	41.9 (76.7)	113(166)	52	2.63(3.86)	8.9202
4	School B	-	-	-	-	-	-	-
5		37	28 (38)	75.7 (100.0)	56(418)	6	1.51(11)	1.51
3		43	30 (37)	69.8 (84.1)	66(117)	10	1.53(2.66)	2.016
4	School C	50	24(41)	48.0 (82.0)	45(266)	12	0.96(5.32)	1.978
5		49	34 (43)	69.4 (91.5)	77(293)	9	1.67(6.23)	1.989

Table 8.1 A brief overview of participants of the study in the out of school time

8.4.2 Interaction

The data was collected in December, 2015. Based on the system's database, there were a total 278 questions and 1454 comments generated. A total of 97 questions and 1004 comments were collected that could be used in data analysis. The same coding scheme from Chapter 6 (Figure 6.2) was applied to do the coding. The observed frequency transition Table 8.2 shows the different frequencies among these different responses that were revealed in the online student-led asynchronous discussion. In addition, the same method of sequential analysis was applied to obtain the significant pattern of interaction responses from the children in the online student-led asynchronous discussion.

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	TEA	REP	DIST
ANS	0	37	21	6	7	2	0	8	18	15	0	0	0
ALA	0	38	12	3	4	7	3	10	21	30	2	8	2
EXT	0	14	22	4	2	3	7	4	13	5	0	5	2
QUE	8	5	0	2	2	0	2	0	1	9	0	0	0
REQ	5	4	1	1	1	0	0	0	2	5	0	1	0
INS	0	6	2	2	0	2	4	0	3	5	0	1	1
SUM	0	1	2	0	0	1	0	0	4	1	0	1	3
DIS	0	1	0	3	0	0	0	0	1	13	0	0	0
AGR	0	15	16	2	0	10	5	2	15	26	0	1	3
EVA	0	16	6	6	5	11	2	3	24	18	0	6	2
TEA	0	8	3	1	1	0	0	0	1	3	0	1	0
REP	0	5	4	1	0	0	4	0	4	2	8	6	1
DIST	0	4	0	0	0	1	0	0	4	3	0	1	3

Table 8.2 Observed frequency transition table in the online student-led asynchronous discussion

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	TEA	REP	DIST
ANS	-1.6	**3.0**	**2.0**	0.5	**2.0**	-1.8	-2.3	**1.9**	0.0	-1.8	-1.4	-2.5	-1.8
ALA	-1.8	**1.7**	-1.6	-1.5	-0.2	-0.2	-1.2	**2.3**	-0.3	0.8	0.0	0.8	-0.8
EXT	-1.3	-1.1	**4.2**	0.2	-0.4	-0.7	**2.4**	0.5	0.1	-3.2	-1.1	0.8	0.0
QUE	**10.5**	-0.6	-2.1	0.7	1.2	-1.3	0.9	-1.1	-1.9	**1.7**	-0.7	-1.2	-0.9
REQ	**7.8**	-0.2	-1.0	0.1	0.5	-1.1	-0.9	-0.9	-0.7	0.7	-0.5	0.1	-0.7
INS	-0.7	0.2	-0.8	0.8	-0.9	0.6	**3.1**	-1.0	-0.6	0.0	-0.6	-0.1	0.5
SUM	-0.5	-1.2	0.3	-0.8	-0.7	0.4	-0.7	-0.7	1.5	-1.1	-0.4	0.6	**4.9**
DIS	-0.6	-1.7	-1.6	**2.6**	-0.8	-1.0	-0.9	-0.9	-1.2	**5.8**	-0.5	-0.9	-0.7
AGR	-1.4	-1.5	1.3	-1.2	-1.9	**2.5**	0.8	-0.9	0.0	**2.2**	-1.3	-1.7	0.5
EVA	-1.5	-1.5	-2.1	0.9	1.2	**2.8**	-1.0	-0.4	**2.5**	-0.3	-1.3	0.9	-0.3
TEA	-0.6	**2.3**	0.5	0.2	0.6	-1.0	-0.9	-0.9	-1.2	-0.3	-0.5	0.2	-0.7
REP	-0.8	-1.1	-0.2	-0.5	-1.1	-1.4	**2.4**	-1.2	-0.7	-2.1	**11.0**	**3.8**	0.2
DIST	-0.6	0.3	-1.5	-0.9	-0.7	0.2	-0.8	-0.8	1.0	0.0	-0.5	0.4	**4.3**

Table 8.3 Z- scores for tests of significance (when the z value of a sequence was larger than +1.65, it means that the degree of continuity reached statistical significance (p<.1)), in the out of school time with technology supported student-led discussion

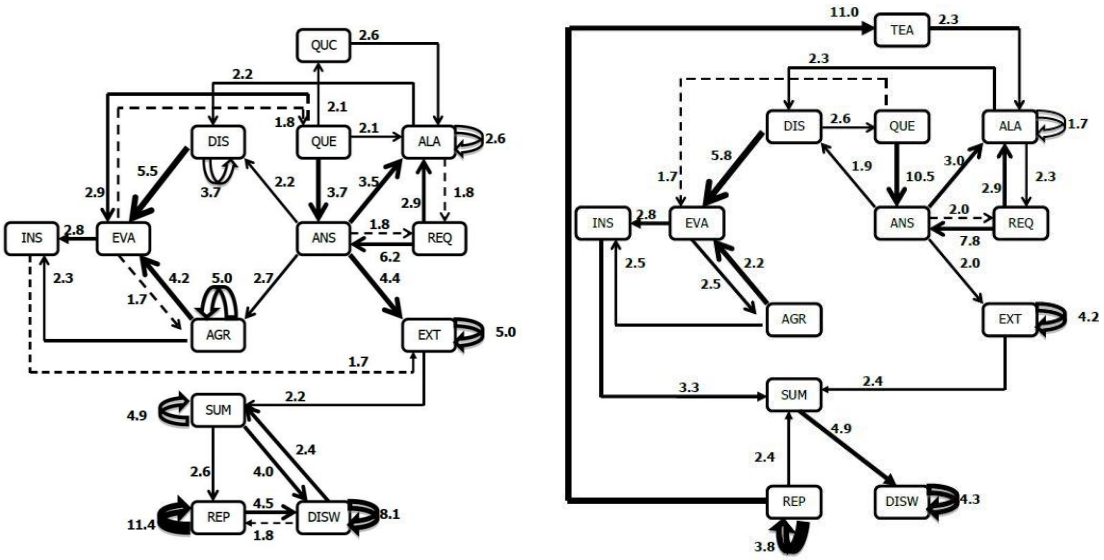


Figure 6.3 behaviour responses transferred from children when they answered questions in the classroom based online learning environment; (Left). Figure 8.1 behaviour responses transferred from children when they answered questions in the out of class time online learning environment**.** (Right).

The significant patterns from the synchronous discussion and asynchronous discussion were similar but less interaction among the interactions for the asynchronous discussion (see Figure 6.3 & 8.1).

In the second phase of the children's interactive model, there was no significant pattern between the reactions of answer to the reaction of agreement. In addition, the reaction of disagreement and agreement did not lead to themselves unlike in the synchronous discussion. The relationship between the reaction of questioning to others such as evaluation and alternative answer was not significant. In the asynchronous phase, the weight of significant patterns from the reaction of evaluation to the reaction of agreement had increased. Other significant patterns were similar to the online synchronous phase. In the asynchronous phase, the reaction of inspiration had a significant pattern with the summary directly in this study.

The significant difference between the results of the online synchronous discussion and the asynchronous discussion was in the second part of this significant pattern. As mentioned in Section 6.4.2 Chapter 6, in the online student-led synchronous discussion, there was a very strong loop amongst the summary, repeated answer and distillation. In order to reduce the repeated answer and lead to a deeper understanding of this question, in this study, the role of the teacher was introduced to post sub-questions to lead students to think more deeply about those questions. This was why the reaction of the repeated answer led to the reaction of the teacher. Then additional answers provided by students were regarded as alternative answers. An example which illustrates this situation was where a teacher wanted to test students' understanding about structures which were shaped like an arch and the topic was about force (see Table 8.4). The teacher asked students to try and find something that was shaped like an arch or spherical structure in their daily life. The students initially pointed out different examples but then began to point out similar answers. So the teacher posted another question to ask students to think about why they designed this structure rather than another structure, which helped the students to think about the subject in relation to the topic which was about force in science. This allowed the teacher to understand how much the students already knew about the topic of the structure of arches.

Question: for year 6 student (for school C)

Can you find something which is shaped like an arch or spherical structure in your daily life?

Egg shell.	Year 6
Bridge	Year 6
Human foot bones is arch.	Year 6
…	(many others questions)
Thanks for everyone sharing different examples of arch structure. Do you know why they are designed in the arch structure?	Science teacher
It can help to handles compressive loads...	Year 6
Human foot bones is arch which can help to support the body.	Year 6
It helps to distribute the force into different parts	Year 6
…..	(other questions)

Table 8.4 An example selected from the transcription to illustrate how teacher played a role in the discussion.

8.4.3 Result of applying an online student-led discussion in blended learning

As discussed in the Chapter 7 (Section 7.5.3), the result of teachers' feedback of interview implied a new function was needed for teachers to review students' contribution which could allow the teacher to tailor the curriculum design based on students' preconception and identify how students interact with others during the discussion. The extended function of visualization of students' contribution was designed in the prototype, which provided opportunities for teachers not only review students' contribution (see Figure 8.2) but also get an overview of their answers and interactions (see Figure 8.7).

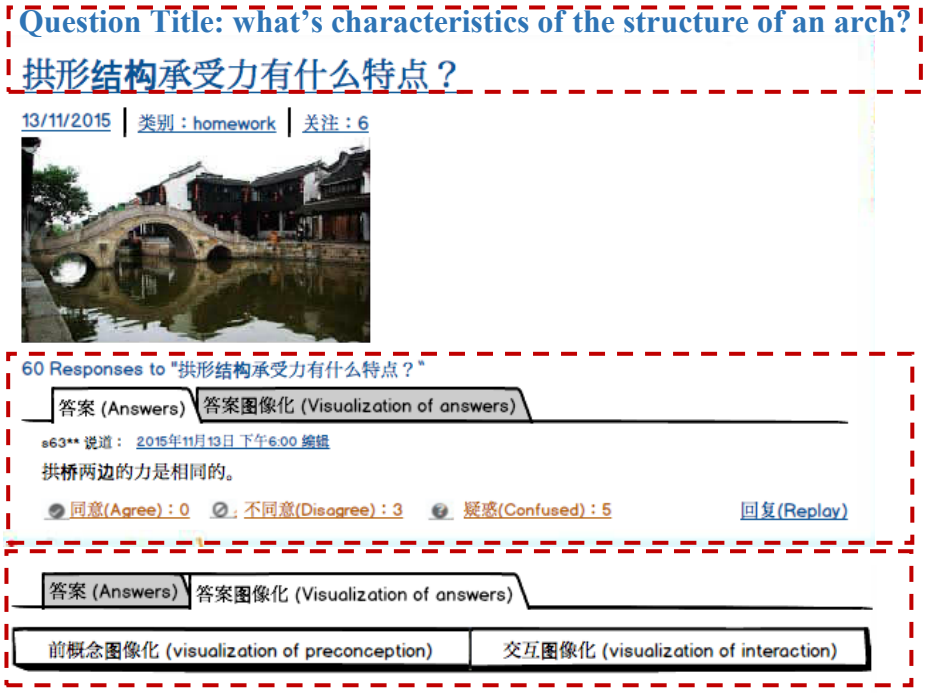


Figure 8.2 Interface of extended function in question view page (Up); Figure 8.3 Two specific functions (visualization of preconception, and visualization of interaction) included in the extended function of visualization of answer (below).

8.4.3.1 Visualization of students' preconception

In this study, one science teacher posted the question about the characteristics of the structure of an arch in the task section of the online student-led discussion for students from Schools A and B to answer. A total of 24 out of 40 students from Year 6 and 3 students from Year 4 from school A answered this question. The science teacher was able to select the function of visualization of preconception to gain insight into the students' understanding of the topic (see Figure 8.4 ②). For example, the teacher from school A searched students from school A to review their preconceptions of characteristics of an arch bridge (see Figure 8.4 ③**)**. Figure 8.4 presents the example of visualization of students' answers in a pie chart which was easier for the teacher to rapidly get a sense of what the percentage of students' preconceptions was for each point (see Figure 8.4 ④). Additional, when the teacher clicked on each sector of the pie chart the appropriate page of students' ID numbers and their answers, which were collected from the database, were presented to the teachers. For example, when the science teacher wanted to know which students pointed out answers such as "keep the bridge from being destroyed by the flood", they clicked orange sector of the pie chart which lead to detailed information as shown in Figure 8.5 ⑤.Figure 8.5 shows that there

was one student (s43**) who posted this answer and also attached this students' answer. Due to ethical issues students' name cannot be identified here, the example of s43** is shown in the example. There were four main points that students answered to the question of the characteristics of an arch shaped bridge. Fifty percent of students pointed out that an arch shaped bridge helps to distribute force, and 46% pointed out that the arch shaped bridge can help to withstand very large forces compared with bridges of other shapes. Four percent of students answered that this kind of bridge would not be easily destroyed by flood. The fact that the point of force would be distributed by an arch shaped bridge was also classified into two different preconceptions. Half of the students thought that an arch shaped bridge would help to distribute force into all parts, but the other half of students thought it could help to distribute the force into both end parts.

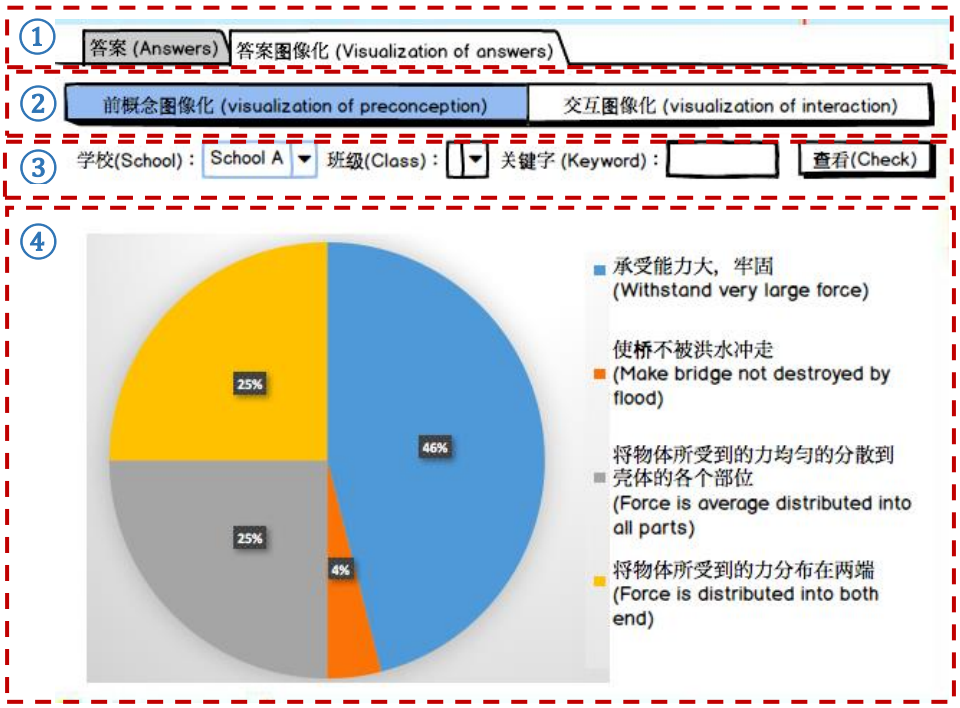


Figure 8.4 Four main characteristics highlighted in the function of visualization of answer

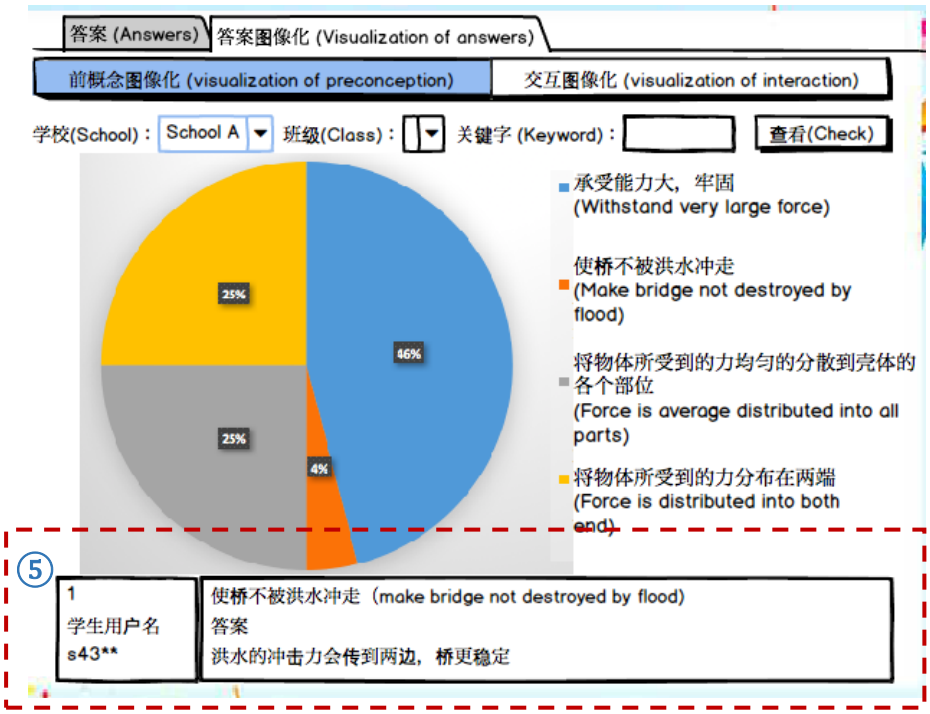


Figure 8.5 detail information of specific number of students and their answers reviewed

Students' answers to the same questions in School B showed different preconceptions in their understanding of an arch shaped bridge. These are shown in Figure 8.6 ④,⑤. There were a total of 20 out of 37 students from Year 6 and 1 student from Year 5 who answered this questions.

There are three points that the students explained. Two of these points were similar to the ones that the students from School A pointed out about withstanding a very large force and that the force would be distributed across the entire span of the bridge. However, students from School B also mentioned that the force distributed into the two abutments would be equal. In addition to the fact about the points of force being distributed, there were five different parts in which the students of School B had different preconceptions about compared to the students from School A. The main difference in the answers was about how the force would be distributed by the arch of the bridge. Only 19% of the students mentioned that the force would be evenly dispersed. Nine percent of students more specifically described that the force would be evenly dispersed around. Thirteen percent of students only mentioned that the force would be distributed around. Nine percent of students explained that the arch of the bridge would help to distribute the force sideways, in both directions. Another 13% students explained that the load leads to a downward force.

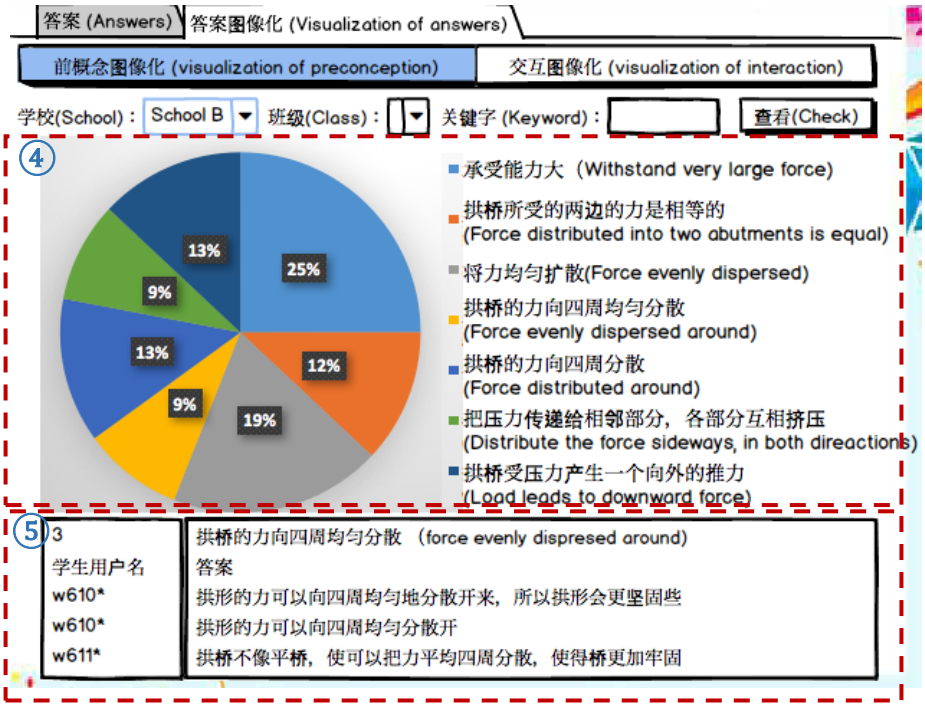


Figure 8.6 interface of visualization of students' preconception from year six students in school B based on same question

After presenting the results to the teachers they were able to get a sense of what the students' preconceptions were regarding the characteristics of the arch of a bridge. Based on the results, it would become apparent to the teacher that the students had different preconceptions regarding how force was distributed by the arch of a bridge. The teacher would then be able to use these results to modify their curriculum design earlier to incorporate how the students came to have a misconception of this topic and to explain how force would be distributed by the arch of a bridge.

8.4.3.2 Visualization of students' interaction

The answers contributed by students can not only help teachers to get an overview of student preconceptions but also help the teachers to see how students interact with each other during the online discussion.

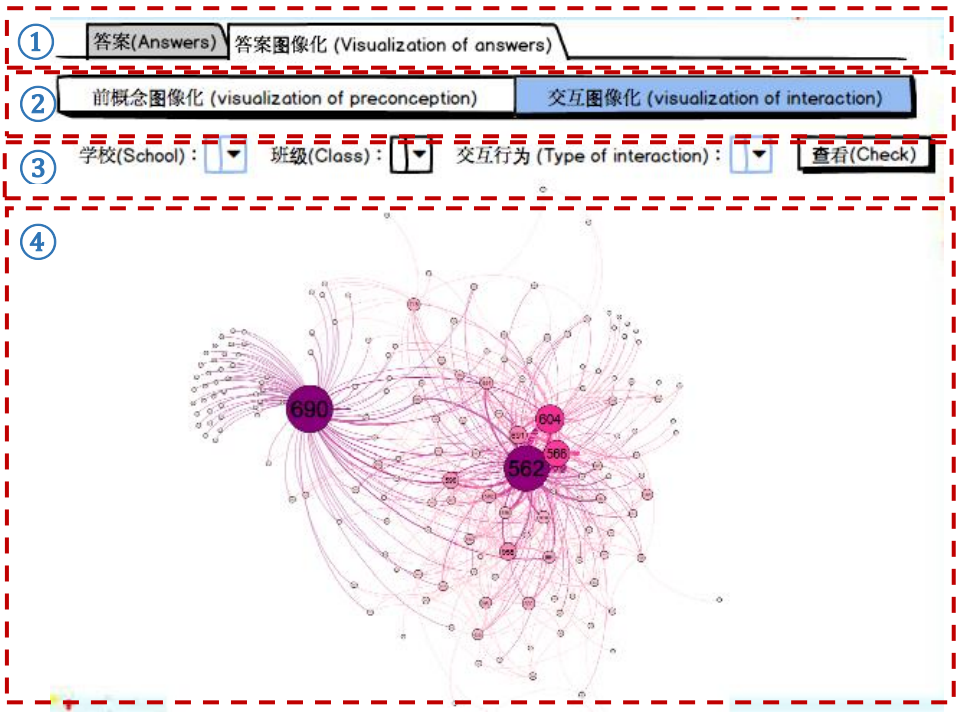


Figure 8.7 the interface of visualization of students' interaction

Gephi visualisation software was used to plot the information collected from the system log (as explained in Chapter 5) as a way of visualising the relationship between all the students who took part in the discussion (see Figure 8.7 ④). Visualization of students' interaction could help teacher to identify how each student active or inactive interact with other students during discussion. Additional, teacher also can compare their reactions when they are in the class talk. Each node in the diagram represents a user, and the edges their relationship to other users. Edge thickness relates to the frequency of interaction between the two users. Different types of interaction can be plotted. For example a user responds to a question from another user or a user responds to another users' comments. The diagram also allows the evaluation of "indegree" – the number of edges arriving at a node – and "outdegree" – the number of edges emanating from a node. If a user asked a lot of questions their outdegree for that aspect will be large, if a user received a lot of answers the indegree would be large. Two different aspects are illustrated in Figure 8.8 below which presents the result of interactions when students received comments from others. Larger nodes means the users received more comments. Some unconnected nodes highlighted in the figure 8.8 show that some users did not receive any comments from other students. Figure 8.9, represents the result of the interaction when students post comments to others. These different visualization of interaction results could help teachers to identify how activly students have interacted

with others during the discussion and compare this with their behaviour in the traditional learning environment.

The teacher can also choose to review other types of interactions.

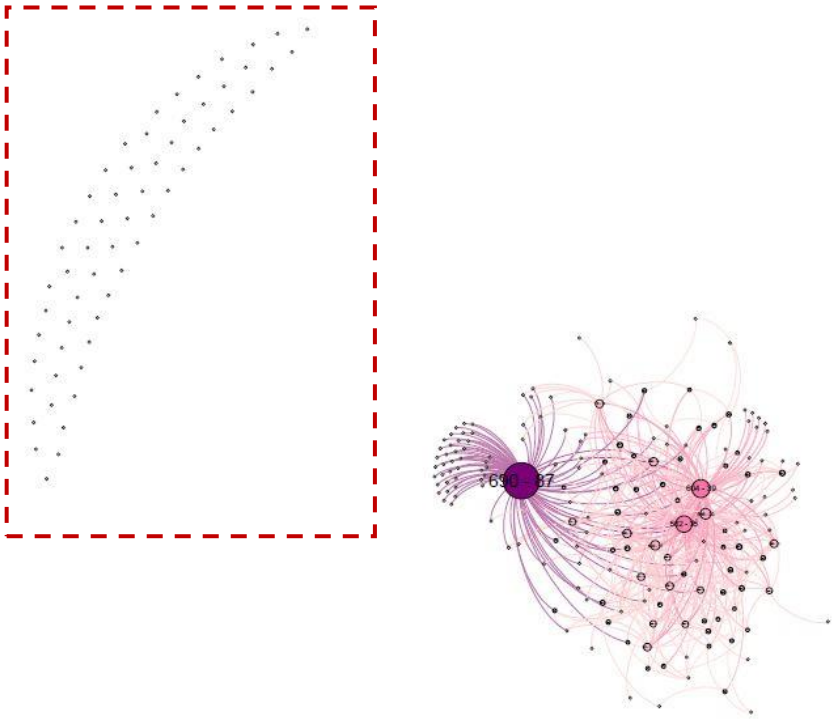


Figure 8.8 the example of indegree interaction of students based on the Gephi's result.

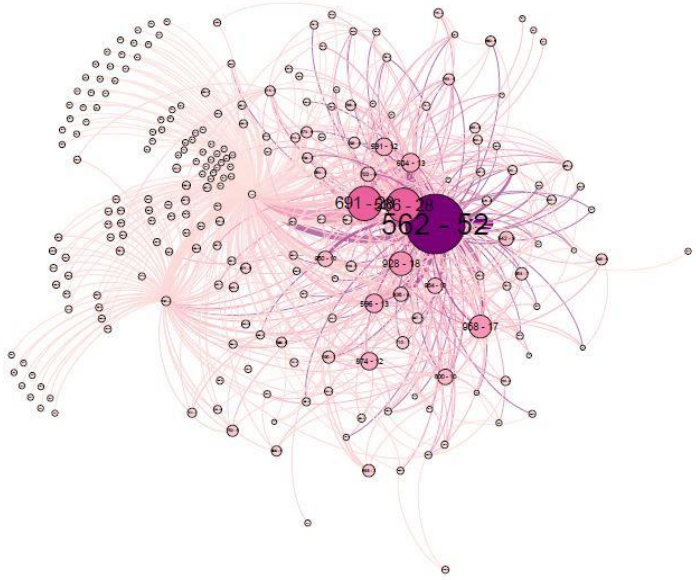


Figure 8.9 The example of outdegree interaction of students based on the Gephi's result.

8.4.4 Evaluation of the application from the student's perspectives: learning experience

The aim of the interview was to evaluate how the application of the online student-led discussion combined with their face-to-face classroom learning would affect their learning experience. It also explored what kind of factors would influence their behaviour in using the application. There were three main issues discussed during the interviews. Firstly, the students were asked to describe the traditional way that they would prepare to learn the topic and then to compare this with the new ways with technology support. Secondly, based on the results of data obtained from the website, it was found that not everyone posted answers on the platform and some answers were similar. The interview questions were designed to explore the students' behaviour in the online discussion. Finally, it aimed to ask students to provide suggestions on this new way of learning to help define the model. Three main themes emerged from the thematic analysis (see Figure 8.10). These shed light on the students' perspective of how the application of an online student-led discussion combined with traditional learning would affect their learning experience and also how students' contributions would affect the result of this application.

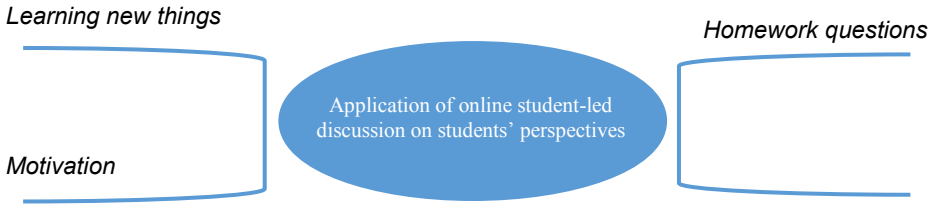


Figure 8.10 The major themes elicited after interview with students on evaluation of application online student-led discussion on students' perspectives

8.4.4.1 Learning new things

Most students pointed out that the application of an online student-led discussion could help them to learn new things, which is the same theme that emerged from the interview of students in Section 7.4.1.3 when they evaluated the tool of the online discussion. The categories of 'help others learn' and 'learn from others' are the two main points relative to learning new things after using the application of student-led discussion for their learning (see Figure 8.11). Although they also mentioned these two categories when they evaluated online discussion tool in the classroom, they focused more on how the tool affected their experience of learning new perspectives. In this interview, they pointed out more specific examples to illustrate how exactly they considered the effects upon them of learning new things to be from the two perspectives of helping others to learn and learning from others.

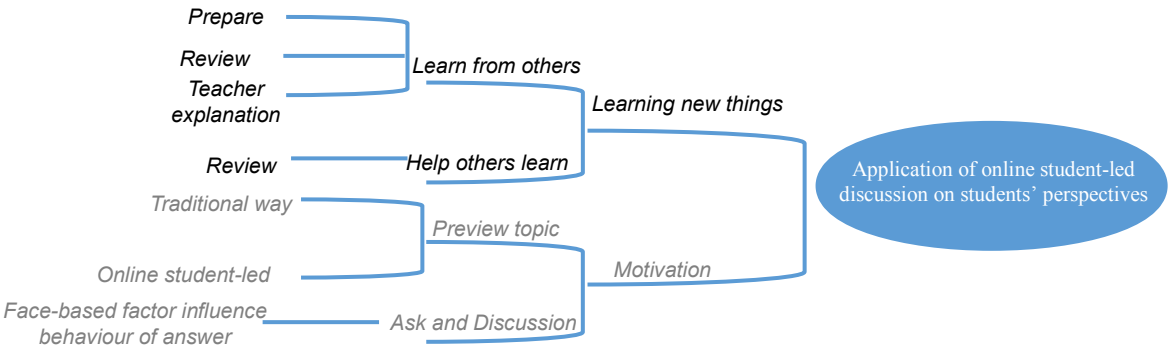


Figure 8.11 The following categories elicited in learning new things and motivation categories

8.4.4.1.1 *Help others to learn through peer review in the application of platform in learning*

During this study, students from different years discussed their learning together. This is despite the fact that the guidelines provided to instruct students on the implementation of this study did not ask them to answer homework from other schools and from students from different years. However, the results of the study showed that students from different schools and different year groups joined in the discussion together. Students pointed out that reading other students' answers, especially from students of a lower year, helped them to review their answers and through that process to learn better.

"Looking at the question and answers from the lower years or different schools, firstly, I can review whether I still remember what I learnt before. Secondly, I also can help to review whether students answer correctly from the lower year. If their answer is wrong, I can point it out, then they will know whether they are wrong or not."

8.4.4.1.2 *Learning from others by gaining more knowledge from the discussion and explanation*

As well as helping others learn, most students pointed out that they could learn from others which led them towards learning new things. As the students mentioned that they could help to review comments and answers by lower year or similar year students', which would help others learn, the payoff was, in fact, that the process of reviewing other students' answers also helped them to reflect on their own current understanding to see whether they still remembered the information that they had already learnt, or whether they could still answer the questions. If they forgot or couldn't find an answer or solution to the lower year's questions they would try to see how the other students' answered and learn from it.

In addition, being able to preview the answers from students one year above them allowed them to learn about what subjects they would be studying in the future. The students mentioned that they were very curious about the subjects they would learn later. Reading the questions and answers from the discussion could benefit them in learning more about the subjects.

The most different part they experienced was that this kind of blended learning environment could help them to consolidate their understanding of the subject and to better understand the explanation from the teacher.

"It can allow me to post my answer to the online forum first of all, and interact with students. I did not really know whether my answer was correct and not. I also read the answer post from the other students, which can help me to see how other students' thinking processes work and to reflect on my understanding as to whether it is correct or not. But after the teacher explained the answers we posted online, I can understand better compared to the usual way I experience. I can understand this knowledge point better and where I had understood incorrectly previously."

"Discussing first online and learning in the class could help to consolidate the knowledge delivered by the teacher."

As with the limitation mentioned by the students' in the pervious interviews (see Section 7.4.2.1), students recommended that the best answer should be provided after the discussion. They argued that the teacher would be better to not join the discussion until they had finished the discussion and the best way for teachers to do this would be to evaluate their answer rather than by the teachers simply providing the correct answer. Due to the process the students underwent with the program the teacher was able to explain and evaluate the students' answers in relation to the topic being discussed in class based on an overview of the results of the students' answers posted online. Most students thought that this kind of application could help them to reflect on their current knowledge and to understand the difference, which would help them to consolidate their knowledge of the topic being delivered by the teacher compared to the traditional teaching methodwhere students passively received this information without thinking.

8.4.4.2 Motivation

8.4.4.2.1 Increasing the interest in previewing the subject

Another theme that students talked a lot about is motivation (see Figure 8.11). They expressed that it was very interesting for them to preview the subject of study in this way compared to the traditional way. In the traditional way that students prepare for the subject that they will study later, they are asked to read the book before teacher then

delivers the subject in class. Most students pointed out the limitation of this method is that it is very boring to keep reading the books.

"Usually, the teacher would ask us to read the book before the topic that they will teach next week. But it is very boring to read the book, there are only a few pictures and concepts in the book. After we read the book, the teacher will still teach the similar concepts that we read before the class. I would like to discuss with other students in the online discussion and know how the other students' think. I also can see how other school students' understand the subject. I feel it's very interesting."

"There is not much information in the book. Most of the information are pictures and some key points of knowledge. I even don't know why I have to read the book."

Most students highlighted that the application of an online student-led discussion tool can help to increase their motivation to preview the subject.

"It can help me to negotiate with other students rather than reading the books. I also can know how other students' understand this topic. It can help to understand much better after I also received explanation from the teacher in class".

8.4.4.2.2 Stronger desire to ask questions and to answer questions online

Students also pointed out that they felt discussing the topic online was better than in class. In the traditional way of learning they feel a strong pressure from their peers and teachers.

"There is no pressure to discuss the science topic with others online; standing to answer the question in class, I feel very pressurised from my classmates and teacher. If you answer incorrectly, everyone in the class will laugh at you, and teacher also will challenge you whether you still don't understand well after several times with them teaching. If the teacher asks you to stand up to answer the questions you cannot answer very well that is very embarrassing. "

8.4.4.2.3 The issue of saving-face and its effect on students' behaviour online

Although most students pointed out that they have a stronger desire to ask questions and answer questions online compared to the face-to-face discussion in the classroom, it still revealed limitations to students behaviour when posting their answers to questions concerning the issue of 'saving-face'. The main purpose to explore the application of online student-led discussion combined with traditional teaching methods is to provide an overview of Chinese students' preconception with teachers which could benefit in tailoring curriculum design and also to provide the opportunity for Chinese students to ask questions of and discuss with others. Based on the results of the interviews many students posted their answers directly to the site. They stressed that reading other answers first helped to influence the answer they had in their mind. They preferred to post their answers first and then to compare with other students' answers. They also thought that posing their own original answer could help to validate their own answer by others.

However, there were still many students who preferred to read other students' answer first and then to post their own answers in the task section. If the students read other students' answers first and then changed the answer to post rather than by showing their answers to questions initially it would be difficult to identify all students' preconceptions or misconceptions from an overview of the results. It will also be difficult for teachers to get a precise overview of the students' current level of understanding of the subject being taught. They explained three main reasons why they read other students' answers first. Firstly, they wanted to think about the answer initially posted by other students before then combining their own answer to post the better response. Secondly, they wanted to avoid their answer being posted online and then finding out that it was wrong. This, they felt, would result in them losing face or being laughed at by other students. After the researcher told them that they would not be identified because their username would be anonymous they showed that they would prefer to post their answer directly.

In addition, as has been mentioned in Section 8.4.1.1, most students like to interact with students from different years, and they can preview and review the questions posted online in the homework section. However, some students pointed out that they were

afraid of being laughed at by students who were younger than them should they post an incorrect answer in the homework section.

A case from the study that can illustrate this situation follows. A true or false question posted by the teacher read “Power supply which includes two batteries will always produce stronger electromagnet than the power supply provided by one battery”. Forty one students from the three different schools answered this question. Two of them were from Year 4 and 2 of them from Year 5. Below are several example responses to the question to illustrate the students’ behaviour when answering this question (see Table 8.6).

Answer	Author
错的，因为他们的电量输出是一样的 (wrong, because the quantity of electricity are the same)	**Year 6**
错的，因为两节电池和一节电池输出的的电量是一样的 (it is wrong, because the quantity of electricity produced by the two batteries is the same as the electric charge produce by the one battery)	**Year 6**
是错的因为点流是一样的 (it is wrong, because the current flows through is the same)	**Year 6**
.....(many other answers)	
错，电磁铁磁力大小与线圈匝数、铁芯大小、电流的大小有关，只确定电流大小之外还有两个变量也要相同才能说磁力大小一样，而这里只说电压大小不同，电流大小还跟电阻有关，所以不能确定。(Wrong, There are three different factors relative to the strength of electromagnet.1. Wrapping the coil around an iron core. 2. Adding more turns to the coil. 3. Increase the current flowing through the coil. Here only present how strong the current is but without talking about the other two factors.)	**Year 5**
错，两节电池和一节电池输出的电流都是 1.5v 电量是相等的 (Wrong, the current flowing from one or two batteries is the same which is all equal to 1.5v)	**Year 6**
.....(many other answers)	…
不一定。因为电磁铁磁力大小与线圈中电流的强度有关，电流 越大，电磁强度就越大。如果同样的 2 节电池串联的话，它的电流和 1 节电磁的电流是一样的。如果 2 节同样的电池并联的话，它的电流为 2 节电流的总和，这时，2 节电池的电流就比 1 节电池的电流要大。(Not always. How strong the electromagnet is, would be relative to the current flowing through the coil. However, it only talked about one and two batteries without mentioning whether these batteries are connected in series or parallel. If batteries are connected in series, the current from two batteries will be the same as the one battery. If two batteries are connected in parallel, the current is the sum of two batteries, which is stronger than the current from one battery.)	**Year 4**

…	
错，因不知是并联还是串联 (wrong, because we don't know how the batteries are connected)	**Year 6**
.....(many other answers)	

Table 8.5 example of the answers posted from students to the question of "A Power supply which includes two batteries will always produce stronger electromagnet than the power supply provided by one battery"

There are various answers that students provided to answer this question. There are three main types of answers that can be classified. Firstly, most students pointed out that this statement is wrong, because the current produced by the power supply is the same or the quantity of electricity is the same. They use various words to represent the "electric current". Secondly, only a few students mentioned that it is wrong because they did not mention the coil wrapped around an iron core and turns to the coils. How strong an electromagnet is, is determined by these three factors. In this statement the students only mentioned the current without mentioning the other two factors. Very few students highlighted that this statement did not mention how the batteries were connected. If the batteries were connected in series or parallel, would influence how strong the current would be that would flow through the coil.

The interviewer asked the students why they all answered because of the same quantity of electricity or electric current. Most students explained that they read other students' answers first and were afraid to mention different answers to avoid showing an incorrect answer. In addition the topic of how batteries are connected in series or parallel and the effect this would have on the current was taught in Year 4. Students from Year 6 highlighted that they had almost forgotten about it.

8.4.4.3 Questions designed connected with daily life were promoted by students

Students also pointed out that questions teachers posted in the task section should focus more on the connection between the knowledge required in their daily life rather than only focusing on the science topic.

"I would like more questions about the application of this science topic. For example, the knowledge point is the same but applied into learning in our daily life."

"Experiment. I like experiments very much. (Many experiments we conducted in class are not real, and it is very limited time for us to conduct the experiment in class. We like the experiment in the out of class time and we like this learning to connect with our lives.)

"I like the questions designed to be more related to our daily life. The questions posted from this platform about why there is a layer of oil on the top of the pen ink is my favourite question. It is very interesting and I was also very curious about it."

Most students gave reasons to explain that they wanted the teacher to ask more questions relative to their daily life rather than only focusing on the subject itself.

8.4.5 Feedback from the teachers' perspectives

Most teachers agreed that this blended learning environment could help to define students' prior experience. They also tried to use the data to connect with the study topic to present students' misconceptions during their taught class. The following two examples illustrate how this on line discussion could help to define students' misconceptions and benefit the teachers' understanding of the nature and extent of these misconceptions.

Based on the overview of what students' preconceptions were of the characteristics of an arched bridge (see Figure 8.5 and 8.6), the teachers stressed that it helped them to understand more about the students' preconception of this topic. For example, most students' understood that an arched bridge would help to withstand a very large force and they also knew that the structure of the arched bridge would help to distribute the force to withstand more forces. But they did not clearly understand how the force was distributed by the structure of an arched bridge or similar arched structure. Based on the results of the overview of the students' preconception, there were two main areas of conflicting understanding about how the force is distributed in School A. In school B, students had a different understanding about how the force was distributed. The teachers could then design the curriculum to explain how an arched structure could withstand

force and how force would be distributed and also explain to the students why their answer was not correct in certain aspects of their explanation.

The second example concerns the question of whether it was true or false that a power supply that includes two batteries would always produce a stronger electromagnet than a power supply that includes one battery, revealed further misconceptions with the students (see Table 8.6). In fact, with this question in the examination the students only needed to say whether it was true or false. Based on the results of the students' answers, they were all correct because all of them pointed out that the answer to this question was false. However, based on their explanations most students were, in fact, wrong. Two main problems were exposed by this question. Firstly, they misunderstood the terms "electric current", "electric voltage" and "electrical quantity". Most students pointed out that the electrical quantity produced by one or two batteries was the same. Some students pointed out that the electrical current produced by one or two batteries was the same or that they were all 1.5V, so this statement was wrong because the magnitude of the magnet field would be decided by the electrical current which was the only one of the three factors that mattered. The teacher highlighted that they did not understand the definition of current, voltage and electrical quantity well enough, so they just used the words they understood from their day to day life to explain what they thought. In this situation, the teacher initially highlighted that the term electric quantity cannot be used here. Then they explained clearly each definition and why the students were incorrect in their responses.

"The definition of current intensity is the magnitude of an electric current as measured by the quantity of electricity charge crossing a specified area of equipotential surface per unit time. You cannot only talk about electric charge quantity alone. It also depends on the quantity of electric charge crossing a surface per unit of time. Additionally, the students still didn't learn the concept of electric current and electric voltage until middle school, therefore they will be confused by using this concept to explain the answer. However, they mentioned that the electric current is the same followed by the supply power with one battery and two batteries."

The teacher explained that this question was actually to test whether students understood the factors determining the intensity of the magnetic field and not simply

about the electric current. The intensity is also determined by the way in which the coil is wrapped around the iron core. A second problem also emerged which was that the students mentioned how the batteries were connected (whether in a series or in parallel) and suggested that this could have an effect on the intensity of electrical current. The only students who mentioned this were the Year 4 students. In fact, the aim of this question was not to test whether batteries connected in series or parallel could determine output power. Most students from Year 6 actually forgot about the other aspects of battery usage and power as it was taught to them in Year 3. Only two students from Year 4 mentioned this."

The teachers agreed that the overview summarising the students' responses from the online discussion would help them to define the students' preconceptions and understand the detail of misconception that they have. They could then tailor the main points from the online discussion into the curriculum design to reflect their students' current level of knowledge to further enhance their classroom learning. However, there was still one limitation that teachers pointed out after they applied this blended learning situation. As explained before, a major issue affecting teachers was the amount of time it took to understand students' previous experience and understanding and to reflect this in any classroom teaching. The teachers agreed that an overview of students' thinking in the online discussion helped them to gain an understanding of the students' current levels of knowledge. However, the length of time taken for them to look in detail at the students' responses as well as combining this information into the curriculum design would still be very long.

8.5 Discussion

8.5.1 The application of a student-led online discussion platform as a blended learning environment for students' learning

In the traditional Chinese teaching strategy a teacher will ask students questions to gain an insight into their understanding so that they can then set suitably pitched work for their self-directed study at home. In the classroom the main teaching strategy that teachers adopt is to deliver the teaching in accordance with the national curriculum and to ask specific questions to test whether the students understand the topic they are being

taught. Chinese students uncritically accept and memorise the "standard textbook" content without thinking deeply about it or with any degree of understanding. However, students' minds are not simply blank slates to receive and understand all information and knowledge taught by the teacher(Driver, 1985). As supported by many researchers (Driver, Guesne,&Tiberghien, 1985; Kwon&Oh, 1988; Kwon & Lee, 1993; Pfundt & Duit, 1994), most students come with their own preconceptions that are different from scientific conceptions, which makes students feel that it is difficult for them to learn new subjects and information especially in the field of science (Brown, A. L., & Cocking, 2000). Since children have their own different experiences that make a difference when interpreting information, it can be difficult to change such opinions when they receive the same or similar information, from an alternative source. Children may prefer to use their own experience to illustrate new knowledge rather than examples provided by a teacher (Driver, R., Guesne, E., & Tiberghien, 1985). In this situation misconceptions are easily made as a result of misunderstandings. For example, many people who attend the same lecture and accept the knowledge imparted by the same teacher can still interpret it differently because different individuals have their own way of processing information. (Driver, R., Guesne, E., & Tiberghien, 1985). Therefore, many researchers argue that it is difficult to change students' preconceptions by simply informing them of scientific concepts.

In this study an online student-led discussion platform has been used as a tool to try to compensate for the drawbacks of the traditional classroom teaching methods. Using technology as the intervention provides the opportunity for students to present their preconceptions by showing their standpoints during the discussion and stimulates the factor of cognitive conflict for students to become involved in different reactions such as reflection, comparison and negotiation for building and consolidating knowledge through processes of assimilation and accommodation (Hamer et al., 2010). Combined with explanations from teachers in the traditional teaching strategy this blended learning strategy could increase the potential opportunity for them to achieve conceptual change.

The traditional method for asking students to read the textbook to preview the knowledge of a subject that teachers would teach later in the classroom environment results in students feeling very bored. As students mentioned in the interview the information they derived from their pre-course reading is exactly the same information

that the teacher will then deliver in the classroom. The students stated that it is very boring to keep reading information only for memorisation. Additionally, students highlighted that teachers will try to test their understanding of the subject being taught in the classroom by asking several questions, which makes them feel great pressure to formulate the correct and expected answer for the teacher. In the online student-led discussion platform they argued that it can increase their motivation to learn more about the subject that they will study in the classroom and that it gives them a stronger desire to ask questions and discuss the topic with others. Students pointed out that it is a way to learn from others and help others learn through discussion with others. The key theme coming out of the interviews held with students was that most of them felt that there was a benefit in them learning from others when using the online discussion platform. They can compare their own ideas with others and then negotiate with others to define the difference between other students' answers with their own answers. Students also agreed that discussing with others via the online platform and then receiving an explanation from the teacher in the classroom could help them to understand the subject better than simply receiving the information from teachers without thinking.

However, many limitations and challenges were also revealed by the study. Firstly, the number of students who participated in the out of school study was less than the number of students who participated in the online synchronous discussion in the classroom, but was still more than the number of students who participated in the face-to-face synchronous discussion in the classroom. There are many factors which would influence the number of the students who participated in the online discussion outside of school time. On the one hand, Chinese parents have a misconception of the role of the computer in students' learning. They believe that using a computer could not benefit with students' learning (Jing, 2012). Students could play games or do something irrelevant to their learning. Chinese parents would forbid students from using computers in their out of class time study. On the other hand, Chinese students have a lot of homework that they need to do in their out of class time study which leads to limited opportunities for them to access the online learning platform out of school time. Additionally, most students may attend a class which is curriculum based supplementary learning which helps them to improve their academic achievement. Chinese students may also attend other clubs to pursue their own personal interests such as calligraphy and dancing that are irrelevant to the curriculum or school subjects which

could mean that students do not have enough time to access the online learning platform. Secondly, the reduction in the number of participants also leads to less interactive discussions out of school time. The role of the teacher in the discussion was to ask deeper sub-questions with the intention of reducing the amount of repeated answers generated by the students. Asynchronous discussion increases the waiting time to get the answer from others. As pointed out by the students in the interview, the feeling was that it takes long time to get responses from others when answers or questions were posted out of school time. In the classroom interaction students could get responses immediately after they posted their questions or answers. Thirdly, the issue of saving-face had a huge impact upon the students' behaviour when posting their answers online. Some students would read others' answers first to compare the others' answers with their own. It would influence the answer they posted during the discussion, which meant that teachers were not able to exactly gauge the preconceptions of students understanding prior to the lesson.

8.5.2 Application of student-led online discussion as a blended learning environment for teachers' teaching

The conception of technology as practical approach for their teaching and learning from Chinese teachers is also equivocal. Chinese teachers agreed about value that technology contributed on the Chinese students' learning, however, no one identified it as a central teaching and learning method. The issue of this being a time consuming was a big consequence reported by the Chinese teachers. This application of a student-led online discussion as a tool tried to help Chinese teachers to define the preconception of knowledge and different degree of interaction from Chinese students and to provide the overview of the results in a visualised way to save the teachers' time. It will help teachers tailor the curriculum design based on the results of students' preconceptions rather based on the teacher's own experience. Additionally, the overview of students' interaction helped the teachers to monitor how active students were in interacting with other students during the discussion compared their behaviour in the face-to-face traditional learning environment. However, based the result of the teachers' interview, teachers also pointed out that the existing challenges and limitations they faced were still in evidence. Time is always the big issue for the teachers. Each Chinese teacher needs to teach on average four to five classes per day which means they will teach an

average of 200 students. Having an overview of the students' answers to pre-set questions by the teacher would help them to gain a quick understanding of the students' knowledge of the subject and would help them to reflect on their curriculum design, but it still needs time for them to familiarise themselves with this new approach to teaching. It will increase their workload whilst they redesign the content of the class curriculum and when designing new questions for students as part of their online homework. However, whilst most teacher pointed out that it took time to familiarise themselves with this new approach it did not detract too much from their current teaching strategy despite spending more time on the early adoption of the online platform. The things they needed to do such as designing the questions, and reading the overview result of students' responses was similar to the key concept of work they normally undertook. The only difference came when the teachers posted the questions online and when it came time to tailor the results into the curriculum design. In comparison to a totally new approach which could be applied in the class, the teachers felt that they would accept this blended approach as complementary teaching strategy for students learning.

8.6 Conclusion

This chapter mainly focused on how the extended functions of the online discussion tool could not only benefit students' learning and teachers' teaching but also be accepted by Chinese teachers. This application of the online student-led discussion tool in the blended learning environment provided a new approach to learning for Chinese students. Firstly, students could actively discuss with others to preview the topic in out of school time rather than keep reading information only for memorisation. Secondly, this new learning approach increased their motivation to compare their own ideas with others and then negotiate with others. Furthermore, discussing with other students through the online discussion platform helped them to understand the subject when they received the explanation from their teacher in class. This was viewed by the students as being better than being simply taught the information by the teachers without the students themselves having to engage in thinking. Also, the online student-led discussion tool benefitted the teachers' teaching. Firstly, it helped to provide an overview of the students' preconceptions, which benefited them in tailoring the curriculum design. Secondly, visualization of students' interaction also shed light on how active students interact with others during the discussion. Although there are still many limitations and challenges identified, students agreed that this application can help them learn new

knowledge and increase their motivation for asking and discussion. The teachers were happy to accept this blended approach as a complementary teaching strategy for the students learning.

9 Chapter Nine

Discussion and Conclusion

9.1 Introduction

This Chapter discusses the findings and looks ahead to future research. The research questions being answered in the current work were set out in Chapter 1. The way in which they have been answered will be dealt with in this chapter.

RQ 1: Do Chinese students aged 8-11 still engage in student-led discussion based on their Confucian hierarchy-based background?

This was answered in chapter 4. Clearly despite their Confucian hierarchy based background the students were well engaged in the student led discussion.

RQ 2: How does cognitive conflict play a role in student-led discussion and lead Chinese students to challenge the inconsistency they confront and thereby enable them to become involved in the knowledge construction process?

This was answered in chapter 4 also which revealed the ways in which the students could engage in conflict resolution. Chapter 6 covered the differences between the ways the students handled the cognitive conflict in the technology based student led discussion compared with the face to face discussions.

RQ 3: How can technology-based intervention help to provide a stimulus and become accepted by Chinese teachers?

Chapter 7 evaluated the technology based discussion system. It revealed the ways in which teachers and students reacted to and used the system. The students made good use of the system. Chapter 7 brought in the teachers understanding of how they could benefit from use of the tool by allowing them to have the chance to add exploratory questions and get an overview of student responses – thus aiding them in the development of their curriculum. Chapter 8 implemented these functions and reviewed the results of its use.

The following sections will review the value of the study and outline the core contributions arising from this thesis in response to the research questions. Secondly, it proposes the implications of this thesis from three main perspectives (see Section 9.3). The limitations of this research will also be highlighted in Section 9.4. Finally, the chapter concludes with suggestions for future research (see Section 9.5).

9.2 Discussion on the research questions

This section explains how the findings in this thesis illuminate the issue with regard to the research questions proposed in Chapter 1.

9.2.1 Do Chinese students aged 8-11 still engage in student-led discussion based on their Confucian hierarchy-based background?

Chapter 2 posits the approach that suggests Chinese students arrange their own thoughts, negotiations and that they justify their ideas collaboratively through peer interaction (Howe & Mercer, 2007), which is in contrast to formulating the restrictive answer expected in the traditional classroom setting. During this student-led discussion approach, Chinese students have opportunities to ask questions and interact with other students to enhance their learning (Alexander, 2010; DfE, 1999). They also can explore ideas, explain answers, justify argumentation, evaluation and negotiating with others, which helps them to learn respect for one another's opinions and challenge students' initial judgements through discussion (Millett & Tapper, 2012). However, many researchers (Li, Rao, & Tse, 2012; Nguyen, Terlouw, & Pilot, 2006) point out that the new approach which requires students to actively join discussions is not seen as congruent with the traditional Chinese culture and, as a result, would encounter resistance from Chinese students because of the factor of the Confucian hierarchy "face" based background. However, some researchers argue strongly that this over stresses the factors of cultural determinism as a new approach when applied to Chinese students (Cheng, 2000; Dong et al., 2008; Wong, 2004). Dong et al., (2008) explain that Chinese students can make fast adaptations to new patterns of speaking that require free participation and critical thinking based on the results of their studies. They also support Wong (2004) and Cheng (2000)'s arguments that more attention should be paid as to

how to change teaching styles and classroom interactions for Chinese students. The three studies (Chapters 4, 6, 7 and 8) reported in this thesis illustrate that Chinese students can engage in student-led discussions, which are applied in the different learning environments in the following section:

9.2.1.1 Fast adaption to new approach of student-led discussion on participation and interaction perspectives

The findings of Chapter 4 concluded that 38 percentage of students stood up to answer questions in the student-led face-to-face discussion, which can be regarded as a good response from Chinese students compared with their responses in the traditional classroom discussion based on their teachers' feedback. Additionally, there were 522 questions designed by the Chinese students, which included a variety of plant related questions based upon the subject of the growth of plants. Eleven different reactions were also defined from the students' interactions, which revealed that students can be involved in the process of exchanging ideas, explaining answers, evaluating and negotiating with other students to justify their viewpoints in the student-led discussion learning environment. Although some Chinese students took an active role in this student-led discussion approach and showed various reactions to interact with other students in the discussion, the study still revealed that there were many students who did not come forward to present their ideas. In the subsequent experiment a technology based intervention was designed to support Chinese students' discussion, Chapter 6 concluded that nearly 77 per cent of students participated in the activity of posting answers to questions or replied to other students' answers in the technology supported student-led discussion; This is double the average percentage of students joining in the student-led discussion compared to the face-to-face learning environment finding. Significant patterns of interaction revealed in this technology supported discussion also showed more interaction among students in exchanging and negotiating their viewpoints compared to the result of the face-to-face student-led discussion environment. The findings of Chapter 8 concluded that there was a smaller percentage (~68%) of Chinese students who participated in the online discussion outside of the taught class time but this was still a higher percentage than in the face-to-face discussion environment. The significant pattern of interaction also involved a similar but lower rate of interactions than the classroom based online discussion. Additionally, the

findings of Chapter 7, which focused on the evaluation of a technology supported student-led discussion approach for learning from the students' perspective, concluded that students highlighted that it provides the opportunity for them to ask and discuss with students together, and it helps them to learn new things and increases their motivation to ask and discuss with others.

The conclusion of these findings further leads to argue with an existing point from the literature that uses the Confucian culture as the main reason to explain that new approaches are not seen as being congruent with the traditional Chinese culture which would predict resistance from Chinese students. As the findings of the three studies (Chapter 4, 6, and 8) argued, Chinese students rapidly adapt to new patterns of discussion that require free participation and critical thinking. It demonstrated that most of the Chinese students in the study did not resist the new approach for learning, in fact, they also pointed out that this new approach can provide the opportunity for them to freely participate and discuss their ideas with one another rather than remaining passively quiet in the discussion. This they believe would help them to learn new information and gain understanding from other students' ideas. These findings showed that Confucian culture is not deterministic in influencing the Chinese students' behaviour in the new approach, this is contrary to the standpoint of Li et, al. (2012) and Nguyen et, al (2006). The findings also support Dong et al. (2008) and Wong's (2004) points that Confucian cultural background of Chinese students was overstressed as the principle factor to explain Chinese students' passive and quiet behaviour. Current Chinese education system should focus more on the different teaching strategies and classroom interactions applied to Chinese students. For example, in these three different studies, Chinese students still came with the same Confucian culture background, but they were able to present their different viewpoints, negotiate with one another and were able to justify their ideas. Despite the different style of interaction within the learning environment, Chinese students still performed as active learners rather than being passive and quiet learners.

In summary, it is concluded that Chinese students aged 8-11engaged in student–led discussion based on their Confucian hierarchy background. They showed a higher participation rate and different reactions that were relevant to the exchange and they negotiated ideas with others in the discussion. It gave evidence that the Confucian

cultural background is not the main reason to prevent them from joining in the discussion. Different interaction styles and teaching strategies should be focused on that can help to provide opportunities for them to be active learners. Although the Confucian culture cannot be regarded as the key factor in restricting Chinese students from engaging in the student-led discussion (Chinese students can rapidly adapt to a new approach in their learning and show different ideas to negotiate with others rather than being passive and quiet) the factor of the Confucian culture still plays a role in restricting Chinese students behaviour during discussions resulting from their desire to avoid losing face. Chapter 4 concludes that there are still many students who only listen without coming forward to present their ideas in the student-led face-to-face discussion-learning environment. The reason provided by students in Chapter 7 concludes that they were afraid of being laughed at by the other students which would mean they would not wish stand up to discuss their viewpoint in the face-to-face classroom based discussion. Additionally, some Chinese students also pointed out that they would try to compare and contrast with other students' answers first of all, and then they would modify their answer and post another one which they believed to be better. Although most of the students pointed out that they would post their answers directly and then compare their answers with others. It concluded that the Confucian culture might change the way that Chinese students post their answers during discussions without actually restricting them from participating and showing their ideas.

9.2.2 The role of student-led discussion in enabling cognitive conflict and knowledge construction

As discussed in section 9.2.1, Chinese primary school students voluntarily design questions and give answers in student-led face-to-face classroom discussions. This student-led discussion approach provides an opportunity for Chinese students to ask various questions which are relevant to their desire for knowledge and provides active interaction with other students spontaneously without being concerned about the authority of their teacher. However, as highlighted in Chapter 2.5, the student-student interaction could promote students to actively explore and share each other's reasoning and viewpoints. However, it is also easier for these interactions to lead to incorrect knowledge and information being spread amongst the students than in the teacher led didactic approach. Although many researchers point out that cognitive conflict induced

by giving students with baffling information could help to increase students' motivation to reflect on their existing experience to solve the inconsistency, the effectiveness of cognitive conflict as a strategy was still debatable.

Based on the findings of Chapter 4, there are eleven different reactions when Chinese primary students interact with other students defined (*Answering (ANS); Alternative Answer (ALA); Extending (EXT)* (extend and complement another's answer); *Agreement (AGR); Disagreement (DIS); Evaluation (EVA)*; *Inspiration (INS)*; *Question Complement (QUC); Questioning (QUE),* and *Summary (SUM))* in student-led face-to-face discussion learning environment. These different reactions revealed how students were involved in the dynamic interactive process based on the collaborative learning context. In contrast to the passive learning context in which students were asked to accept the conflicting information they received, the collaborative learning context focused more on how the reactions that students performed helped them present and justify their different viewpoints to others and negotiate with them. For example, the reactions of reject, ignore, exclude and abeyance of conflicting information were regarded as the main concern discussed by many researchers to put doubt on cognitive conflict as a means to induce conceptual change based on the model of Chinn & Brewer(1993) and Piaget (1954). However, in the collaborative learning context, although students may reject and exclude the conflicting information received from other students, they still can actively promote knowledge construction by showing different reactions to negotiate with the meaning. The model (see Figure 4.6) in Chapter 4 Section 4.5.2 was created to explain how these reactions were classified into processes of cognitive conflict that students confronted and the process of assimilation that they experienced. The role of cognitive conflict was highlighted in this model to illustrate that students can use the reactions of disagreement, questioning, requesting, and alternative answer to negotiate with others to achieve better understanding of the information when they were confronted with a cognitive conflict. These interactive reactions support the concept that knowledge is not static and closed where there is always a true and correct answer. It also supported the idea that the role of cognitive conflict could promote dynamic exchanges and changes that occur whereby new discoveries and new explanations of knowledge emerge which helps to achieve better understanding of information rather than simply getting the correct answer.

This main finding of Chapter 4 imply that the focus should not be on how to avoid incorrect answers being posted by students but rather be on how to increase interaction among students to help them justify their individual viewpoints and negotiate with others to achieve better understanding of a subject. The role cognitive conflict played in this student-led discussion helped to encourage students to dynamically exchange different explanations and evaluate the knowledge they understand and to challenge their misconception. Chapter 4 also revealed limitations to do with the students' pattern of reaction during face-to-face student-led discussion. Technology as an intervention was proposed to overcome the limitations and improve the depth of discussions and interaction among the students.

9.2.3 A technology based intervention can help to provide acceptance of student led discussion by Chinese teachers

Technology was proposed as an intervention in student-led discussions to overcome the limitations defined by the findings of Chapter 4 and to improve the depth of discussions and interaction among students. As shown in Chapter 2, technology can facilitate the sharing and creation of knowledge through the peer interaction process. It provides a learning environment to support collaboration between students and thereby enhance their learning process. Chapter 4 concluded with the results of how a technology-based intervention could stimulate different patterns of interactions compared to the face-to-face student-led discussions. However, Chapter 2 stressed that Chinese teachers were sceptical of the role of technology supported collaborative learning. The teachers' view was that a lecture delivered by an authority figure should still be the central vehicle for transmitting knowledge in the Chinese education system. The issue of time and how this can be consumed is a big issue reported in Chinese education. The findings of Chapter 6 concluded that a technology based intervention could help to improve the depth of discussions and interaction among students. Additionally, Chapter 7 reported on both the students' and teachers' perspectives of technology-supported discussion. Finally, the findings of Chapter 7 explored ways in which technology-based interventions could be accepted by Chinese teachers.

9.2.3.1 How technology based intervention helps to overcome limitations and improve depth of interaction

As concluded from Chapter 4, reciprocal interaction should be promoted to inform the process of explanation, justification and reflection. The factors of homogeneity of the group and limited time for interaction were defined as the main reasons limiting interaction. In the technology supported learning environment students from different years (Year 3 to Year 5) participated in the online student-led discussion. Three interactive buttons were designed to allow them to react to the ideas of others and express their cognitive conflict in order to promote interaction. The functions of these buttons were based on the model of children's interactive reactions analysis.

Chapter 6 focused on the three main perspectives that were used to discuss how technology can help to overcome the limitations of the face-to-face interaction and improve the depth of student interaction. Firstly, technology supported discussion encouraged more students to ask questions and join in the discussion. The findings showed that the student participation rate doubled in asking questions and responding to others' answers compared with the face-to-face student-led discussion.

Secondly, more significant interaction patterns and deeper discussions in the threads were revealed than there were in the face-to-face discussion (see Figures 6.3 in Chapter 6). In the technology supported discussion, students from different years were asked to join the discussions where they had different prior experiences about the topic, which made those with more knowledge emerge. The result showed that students who were from different years or who had different levels of previous experience regarding the topic significantly increased the frequency of the responses of disagreement, questioning and inspiration. Additionally, when the results of significant patterns revealed from the online discussion were compared to those from the face-to-face student-led discussions, the reactions of disagreement and questioning were different which led to more interaction with other reactions. It revealed that students more frequently negotiated and evaluated with others to solve the cognitive conflict in the knowledge construction process. The reaction of questioning is regarded as a crucial role in facilitating learners' reflection and knowledge construction (Chin & Osborne, 2010; Choi, Land, & Turgeon, 2005; O'Hanlon & Diaz, 2010). This reaction can also

help to highlighted missing information from learners' explanations and promote learners to consider various contexts and perspectives for each problem when they encounter cognitive dissonance (Festinger, 1957) or "epistemic curiosity" (Berlyne, 1954). This results in promoting more complex and deeper interaction patterns involving knowledge construction during discussions. The reaction of disagreement led to cognitive conflict and promoted negotiation of meaning during peer interaction, but it also needed to avoid highly competitive criticism. Mercer (1995) used the term of disputation talk to describe the interaction as often bringing highly competitive disagreements which make children become increasingly irritated with each other and engage in vehement personal criticism. In the model of the children's interactive responses introduced in the current research (see Figure 4.3 in Chapter 4), the reactions of questioning and disagreement were seen as promoting all forms of cognitive conflict. Comparing Figure 6.3 of Chapter 6 with Figure 4.3 in Chapter 4, demonstrate that there were more different reactions followed by the reaction of alternative answer, which were involved with Phases III and IV in the model of the child interactive interaction analysis.

Thirdly, as discussed in Chapter 4, the role of cognitive conflict plays is very important in the knowledge construction process. It can promote students to react in different ways and thereby enhance the process of negotiation and evaluation of the knowledge. The main purpose of designing three buttons (agree, disagree and confused) was to increase the cognitive conflict experienced by students thus enabling them to move toward a better understanding and to investigate the different reactions students experienced when they were involved with cognitive conflict. Based on the results of the interviews reported in Chapter 6, the cognitive conflict-peer interaction model (see figure 6.9 in Chapter 6) helps to illustrate how students reacted in order to resolve their conflict during peer interaction. Based on this model, there were four main reactions. These four reactions were classified into two main sections, which do not exist separately but with respect to one another. One section is the assimilation process, which helps to strengthen their existing knowledge in their schema. This occurred when students agreed the information shared by other students. Another one was the cognitive conflict process, in which students experienced an intrapersonal process in which the conflict induced the students' reflective reaction including a self-questioning and self-reflection process. The reaction of reflection caused students to self-review whether their answers were

correct or incorrect. If students could not resolve the conflict by themselves, they frequently moved towards the interpersonal process, which focuses on interaction with others to solve the conflict. For example, the reaction of comparing and contrasting their own existing knowledge with others helped them to gain a deeper understanding of a subject. Additionally, the reaction of negotiation helped students to negotiate with others to solve the conflict through different reactions. This has been highlighted as a significant pattern. These are all ways in which technology can help students resolve conflicts and achieve better intellectual development.

9.2.3.2 Ways in which technology based interventions can become accepted by Chinese teachers

From the literature review it was evident that the Chinese teachers' conception of technology supported collaborative learning was limited. Chinese teachers agreed that there were ways in which technology could provide certain value but no one identified it as a central teaching and learning method. There were two reasons behind this. The first was class sizes of 40-50 students combined with the idea that increasing the autonomy of each student would result in the teacher losing control of the class. This would also challenge the school schedule that expects teachers to follow the curriculum closely and to accomplish the content within the limited class time (Cheng, 2010). The issue of time was considered the major factor and changing the way in which teachers worked in the classroom would require a large amount of time commitment in looking after online groups and answering student's questions.

In exploring ways in which technology-based interventions could be accepted by Chinese teachers, Chapter 7 introduced the requirements that Chinese teachers would need to have provided by an online student-led discussion tool. The results of the interviews with the teachers revealed that they believed the online student-led discussion platform would not only provide the opportunity for their students to improve their questioning and argumentation skills (currently lacking in the Chinese teaching strategy) but also provide the opportunity to extend classroom discussion which is not finished within the limited class time. They thought that this technology-based intervention could be applied to the out of class study times to complement their

main teaching method. Information contributed by students in the online student-led discussion revealed students' prior understanding of the subject being studied. Teachers highlighted the time limited opportunities they had to assess students' prior knowledge. The role of previous experience is very important in teaching and learning because all learning involves progress from previous experience (Brown, A. L., & Cocking, 2000). The teachers believed that having an overview of students' prior knowledge available would help them to tailor the design of the curriculum to suit the students' needs. The results of the teachers' interviews and limitations highlighted in Chapter 2 implies that the use of an online student-led discussion tool would support both the teachers' teaching and students' learning.

Chinese teachers can apply this online student-led discussion to allow students to answer the questions they designed specifically for the topic they would be teaching in the following days. Based on the students' questions and discussions a summary would be drawn up of the overall view of students' current understanding of the topic and this information would be provided to the teacher. Teachers could their lessons based on the feedback of the students' current level of understanding of the topic. Teachers could then combine this into their teaching strategy. This new approach to a teaching and learning strategy would avoid the teachers' main concerns because it would leave the lecture based teaching method largely untouched and would not challenge the school schedule for teachers. This new approach could not only provide an opportunity for Chinese students to ask and discuss with each other online but also help Chinese teachers to gain an understanding of their students' level of understanding and allow them to tailor the curriculum to suit that specific class of students.

Chapter 8 evaluated the students' performance in this new blended learning approach and drew conclusions as to whether this form of technology-based intervention was acceptable to Chinese teachers. Students regarded this new approach as improving their motivation to prepare for the topic they will learn in the future compared to the traditional way normally requested by teachers. They also agreed that discussing with others on the online platform and then receiving a further explanation from the teacher in the classroom helped them to understand the subject better than simply receiving the information from the teacher without having to think about it. They were able to compare and negotiate with others first, and then receiving information from the teacher

helped them to consolidate their understanding of the subject. From the teacher's perspective having the answers summarised and classified with the percentage highlighted (see Figure 8.5 & 8.6 in Chapter 8) could help them to understand what information the students did not understand very well. They saw can use the student's answers as examples to illustrate their classroom based teaching. Although teachers implied that the new approach would affect their traditional way of teaching, they were receptive of a change that was not greatly different between from their usual teaching method. The only difference was that they would need to post questions online and then tailor the results into the curriculum design.

9.3 Implications

This section concludes the major outcomes of this thesis in response to the overarching research aim, which is *to investigate how technology can support Chinese students aged 8-11 to have the opportunity to engage in student-led discussions to support their education*.

9.3.1 Implications on Chinese education for teachers and students

The Ministry of Education of P.R.C (2001) claimed that they would like to help students develop their communication and cooperation skills as well as their critical thinking and creative problem solving skills as part of its aim of curriculum reform. They imported many pedagogical programmes developed in the USA and Europe but few of were ever used in the Chinese classroom. The main reason suggested by many researchers (Li, Rao, & Tse, 2012; Nguyen, Terlouw, & Pilot, 2006) for this is that the imported pedagogy conflicted with the Chinese students' culture and way of thinking and were not suitable for Chinese students. However this thesis argues that as demonstrated in Chapter 4, 6 and 8 Chinese students can rapidly adapt to new approaches (student-led discussion) in learning and that they can also engage critically and constructively with each other's ideas rather than being passive and keeping quiet. It draws attention to the thinking by some researchers (Li, Rao, & Tsea, 2012; Nguyen, Terlouw, Pilot, & Elliott, 2009) that the factor of the Confucian culture should not be considered as the key reason to reject adopting new approaches for Chinese students' education. In fact, the findings of this study firstly imply that it is essential to provide an opportunity for Chinese students to join in student-led discussion for learning.

There is no strong evidence from the literature to show the reasons why Chinese students will become passive and lack in thinking skills by the time they reach university when at primary school Chinese students are can be active and critical thinkers. It could simply be due to a lack of opportunity to ask and discuss with others at an earlier age. The findings of this study also imply that whether this new approach is accepted by teachers and schools or not is very important. The teachers, in the current study gave as reasons for not being able to implement new approaches for students' learning of the facts that the system they teach in involves examination-led assessment and the requirement of the school schedule. The findings of the study suggest that it is possible to explore ways to not only use this new approach as a complementary tool to support the teachers' work without conflicting with the current Chinese education system, but also to provide an opportunity for Chinese students to ask and discuss questions in class whilst also improving the efficiency of the Chinese teachers' work.

This study has presented an exploration of how face-to-face student-led discussions, online student-led synchronous discussions and online student-led asynchronous discussions can affect students' learning. In face-to-face discussions, it was easier for Chinese students to show their viewpoints because they did not need to type their ideas into the website. However, it took a long time for each student to take their turn writing their answer, which limited the opportunity for students to present their ideas. In addition, it was also difficult to organize different schools and the different years of students to be present in the same classroom for these discussions. The factor of the Confucian culture also influenced students' behaviour to a certain degree. In the online student-led synchronous discussion students had the opportunity to ask questions and discuss topics without any issues of having to take turns. More interactive patterns were shown in the findings of the synchronous online study. However, students were more liable to write similar answers once they saw an answer that they agreed with. It was also difficult to ask students to join in with discussion that to provide input from their daily lives because they did not have enough time to carry out any necessary observations or search for information in the online student-led synchronous discussion. In the online student-led asynchronous discussion that took place out of class time, there were many factors that influenced the number of students participating in the discussion. Less interactivity occurred than was the case with the synchronous exercise but the pattern of interactions was similar to that of the synchronous activity. However, an

online student–led asynchrony discussion can be applicable to various topics related to the daily life of the students and designed by teachers for the children to interact with out of class time. Such discussion would also help the teachers to assess students' understanding and help them to be able to reflect on the students' awareness of the subject.

The study showed that student-led discussions based on different characteristics of learning environments can be designed into a school's activities. They could provide topic based classes and extended practice classes without having a negative impact upon the school schedule. These school activities such as interesting classes and extension classes are organised for students to extend their interest in a topic which is not a subject that will be examined as part of the school curriculum. For example, teachers could publish homework questions that would reflect on the students' daily life and ask them to observe and discuss using the online student-led asynchronous discussion-based learning environment. Then teachers could also organise the classroom based online student-led synchronous discussion to ask students to discuss the topic that is going to be debated in class.

9.3.2 Implications of the work for the role of cognitive conflict in learning

The findings of this study also imply that the role of cognitive conflict as a strategy in the process of collaboration could promote different reactions from students to promote individual understanding and knowledge construction. It supports the idea proposed by some researchers (Mason, 2001; Chan, 2009; Howe et al., 1990, 1992) that the application of cognitive conflict as a strategy may not make students achieve conceptual change; it may promote the first steps of the process of conceptual change. The proposed model (see Figure 6.9 in Chapter 6) of this thesis fills the gap in the literature over how the cognitive conflict can support peer interaction in online student-led discussions. Compared to passively receiving baffling paradoxes as the strategy to induce cognitive conflict in their mental activities to challenge their preconception (Biggs, 1990), cognitive conflict as a strategy promotes the students to become involved in an iterative process of comparison, reflection and negotiation in peer interaction to help them to resolve conflict. In peer interaction, students are confronted by a number of probable

answers provided by others, which may induce cognitive conflict based on their previous experience. The reactions highlighted in the model would help students clarify each different possibility and come to a conclusion by themselves. The process that students experienced in this model is similar to the best scaffolding processes supported by many researchers (Brown et al., 1993; Goos, Galbraith, & Renshaw, 2002) that in this way they are "involved in mutual adjustment and appropriation of ideas rather than by a simple transfer of information and skills from teacher to learner."(Goos, Galbraith, & Renshaw, 2002)

9.3.3 Implications for the methodology

The findings of this study demonstrate that different reactions defined by this study can be used to build connections to existing instruments and could cover the gap resulting from problems with existing instruments. The model developed by using these 11 reactions contributes to the methodology for analysing Chinese children's interactive reactions. The instruments explained in Chapter 2 that were previously used to assess social interaction all focused on undergraduate students. They were not suitable for the analysis of younger students' reactions. In addition, most instruments did not focus on how sequences of reactions behave in the process of social interaction. For example, Pena-Shaff & Nicholls (2004) and Veerman & Veldhuis-Diermanse (2001) only define how several categories may behave in the process of knowledge constructivism relative to deep learning. They did not focus on how these different categories were involved in the different phases of interaction.

9.4 Limitations of the study

There are three studies examined in this thesis to explore how students performed in different student-led learning environments. Each study was only conducted once (for each of the 4 schools involved) to explore students' behaviour during the discussion. There were time constraints on conducting a study in and full study benefit from a longer time to observe and collect the data. As mentioned earlier in this thesis, students have a heavy study load at school and are in class for long periods of time. As such, the school schedule does not have the flexibility to allow teachers to try out new methods of learning on their students unless they are sure of their benefit. The time devoted by the schools in being involved in this study was already great.

The purpose of this research was to try to design a technology supported student-led discussion platform to provide Chinese students with an opportunity to both ask questions about and discuss subject related questions to assist in their education. It was very difficult to assess how big the difference would be for the students and what changes they might experience after using this technology. The findings of this study can only highlight that Chinese students can perform differently whilst using this platform as they did not show the predicted behaviour of being passive and quiet students. It would to take a long time using this new approach in order to help students to develop their thinking and communication skills. In the future, with sufficient funding to support schools, there is the potential for a large body of research work that could be done to extend this research. The following section will discuss further opportunities for future work in this research area.

9.5 Future work

This study highlights some of the paths that may be of interest for further research and also reflects on the more advanced requirements of technology. The findings of this study highlight how to use technology as an intervention that can be accepted in Chinese primary schools by teachers to support students' learning. Further research could specifically narrow down how to design student-led discussion platforms to bridge the formal and informal learning environment and also how they can be a benefit to the traditional teaching strategy. In the platform function design, it would be possible to explore how to use additional functions such as photos, video, and audio to support students sharing their ideas from their day-to-day life. This would also contribute towards the curriculum design for teachers. Teachers can use the students' contributions as material for teaching students in the classroom. In the data analysis, the students' contribution was shown to be a key resource for teachers. It not only revealed students' previous education and understanding but also helped in tailoring the curriculum design by the teachers. In this study, there was limited time to explore this part to determine how data analysis techniques could help teachers to quickly obtain the result of their students' contributions. It is a most important element in the reduction of time-consuming work for teachers to review the results from students' contributions and to increase the teachers' motivation. Finally, in future research, greater emphasis should

be placed upon the teaching and learning strategy with a view to the development of thinking skills in students. In this study, the effect of the students' motivation to join in discussions in class was not of primary focus. The programs were not designed with specific answers to questions or ground rules that they should follow. In the Thinking Together (TT) program that was developed and tested in the China (Yang, 2016), the program promotes students to use ground rules when they are thinking with others; for example 'I disagree with X, because of Y'. 'I agree with X, because of Y'. Future research can examine the student-led discussion to evaluate whether there would be any benefit to students' thinking skills and understanding if they were studied over a longer time period and by comparing the group to a control group.

9.6 Summary

This thesis set out to answer a number of research questions. The motivation for these was a need to improve engagement in constructivism in Chinese classrooms. Barriers to the use of discussions which had been seen in previous studies with older students were felt to be intrinsic to the Chinese educational culture. However, the study has clearly shown that with the right approach – and especially with the right use of technology – Chinese primary school students can and did partake in a wide variety of behaviours. They were able to resolve conflicts in their own thinking and the technology provided them with means to express their ideas and think through issues without the problems seemingly inherent to the face based Confucian study background. Another finding of great value was that teachers can be encouraged to see how the use of this technology could improve their lesson preparation and led to a more efficient teaching method rather than – as they feared – lead to their having insufficient time to cover the necessary material. A new model of interaction was introduced that extends models used with older students to make them appropriate for primary school use. This has the potential of helping further study in this area to be more efficient.

10 Reference

Alexander, R. (2006). *Towards Dialogic Teaching: Rethinking Classroom Talk*. Cambridge: Dialogos.

Alexander, R. (2010). *Children, their World, their Education: Final report and recommendations of the Cambridge Primary Review*.

An, H., Shin, S., & Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. *Computers and Education*, *53*(3), 749–760.

Anastopoulou, S., Sharples, M., Ainsworth, S., Crook, C., O'Malley, C., & Wright, M. (2012). Creating Personal Meaning through Technology-Supported Science Inquiry Learning across Formal and Informal Settings. *International Journal of Science Education*, *34*(2), 251–273.

Anderson, T. (2005). Distance learning–Social software's killer ap?

Anderson, T., Shattuck, J., & Brown, A. (2016). Design-Based Research: A Decade of Progress in Education Research? *Educational Researcher*, *41*(1), 16–25.

Asterhan, C. S. C., & Schwarz, B. B. (2009). Argumentation and explanation in conceptual change: Indications from protocol analyses of peer-to-peer dialog. *Cognitive Science*, *33*, 374–400.

Asterhan, C. S., & Eisenmann, T. (2002). Online and face-to-face discussions in the classroom: A study on the experiences of'active'and'silent'students. In *Proceedings of the 9th International Conference on Computer Supported Collaborative Learning (CSCL 2011)* (pp. 132–136).

Atkinson, K. E. (2008). *An introduction to numerical analysis*. John Wiley & Sons.

Bakeman, R., & Gottman, J. M. (1997). *Observing interaction: An introduction to sequential analysis*. Cambridge university press.

Barron, B. (2000). Achieving Coordination in Collaborative Problem-Solving Groups. *The Journal of the Learning Sciences*, *9*(4), 403–436.

Bell, P. (1997). Using Argument Representations to Make Thinking Visible for Individuals and Groups. In *Proceedings of the 2nd International Conference on Computer Support for Collaborative Learning* (pp. 10–19).

Berland, L. K., & Lee, V. R. (2012). In Pursuit of Consensus: Disagreement and

legitimization during small-group argumentation. *International Journal of Science Education*, *34*(12), 1857–1882.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Brown, A. L., & Cocking, R. R. (2000). *How people Learn:Brain, Mind, Experience, and School*. National Academy Press.

Brown, A. L. (1992). Design Experiments: Theoretical and Methodological Challenges in Creating Complex Interventions in Classroom Settings. *The Journal of the Learning Sciences*, *2*(2), 141–178.

Brown, A. L., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A., & Campione, J. C. (1993). Distributed expertise in the classroom. In *Distributed cognitions: Psychological and educational considerations* (pp. 188–228).

Bruner, J. S., & Bruner, J. S. (2009). *Actual minds, possible worlds*. Harvard University Press.

Chaiklin, S. (2003). The zone of proximal development in Vygotsky's analysis of learning and instruction. *Vygotsky's Educational Theory in Cultural Context*, 39–64.

Chamberlain, A., Rodden, T., Jones, M., Park, S., & Rogers, Y. (2012). Research in the Wild : Understanding " In the Wild " Approaches to Design and Development. *Proceedings of the Designing Interactive Systems Conference*, 795–796.

Chan, C. (2006). *Historical and cultural background of education in China*.

Chan, C. (2008). Pedagogical Transformation and Knowledge-Building for the Chinese Learner. *Evaluation & Research in Education*, *21*(3), 235–251.

Chan, C., Burtis, J., & Bereiter, C. (1997). Knowledge Building as a Mediator of Conflict in Conceptual Change. *Cognition and Instruction*, *15*(1), 1–40.

Chan, C. K., & Chan, Y. Y. (2011). Students' views of collaboration and online participation in Knowledge Forum. *Computers and Education*, *57*(1), 1445–1457.

Chan, C. K., Lam, I. C., & Leung, R. W. (2012). Can Collaborative Knowledge Building Promote Both Scientific Processes and Science Achievement ? *International Journal of Educational Psychology*, *1*(3), 199–227.

Chan, S. (1999). The Chinese learner–a question of style. *Education + Training*, *41*(6/7), 294–305. https://doi.org/10.1108/00400919910285345

Cheng, V. M. (2010). Tensions and dilemmas of teachers in creativity reform in a Chinese context. *Thinking Skills and Creativity*, *5*(3), 120–137.

Cheng, X. (2000). Asian students' reticence revisited. *System*, *28*(3), 435–446.

Cheong, C. M., & Cheung, W. S. (2008). Online discussion and critical thinking skills: A case study in a Singapore secondary school. *Australasian Journal of Educational Technology*, *24*(5), 556–573.

Chi, M. T. (1997). Quantifying qualitative analyses of verbal data: A practical guide. *The Journal of the Learning Sciences*, *6*(3), 271–315.

Chin, C., & Osborne, J. (2010a). Students' questions and discursive interaction: Their impact on argumentation during collaborative group discussions in science. *Journal of Research in Science Teaching*, *47*(7), 883–908.

Chin, C., & Osborne, J. (2010b). Supporting Argumentation Through Students' Questions: Case Studies in Science Classrooms. *The Journal of the Learning Sciences*, *19*(2), 230–284.

Chinn, C. a., & Brewer, W. F. (1993). The role of anomalous data in knowledge acquisition: A theoretical framework and implications for science instruction. *Review of Educational Research*, *63*(1), 1–49.

Chinn, C. A., & Brewer, W. F. (1998). An empirical test of a taxonomy of response to anomalous data in science. *Journal of Research in Science Teaching*, *35*(6), 623–654.

Chiu, Y. C. J. (2009). Facilitating Asian students' critical thinking in online discussions. *British Journal of Educational Technology*, *40*(1), 42–57.

Choi, I., Land, S. M., & Turgeon, A. J. (2005). Scaffolding peer-questioning strategies to facilitate metacognition during online small group discussion. *Instructional Science*, *33*(5–6), 483–511.

Collins, A. (1992). Towards a design science of education. In *New directions in educational technology* (pp. 15–22). Springer Berlin Heidelberg.

Collins, A., Joseph, D., & Bielaczyc, K. (2004). Design Research: Theoretical and Methodological Issues. *The Journal of the Learning Sciences*, *13*(1), 15–42.

Cronbach, L. J. (1975). Beyond the two disciplines of scientific psychology. *American Psychologist*, *30*(2), 116–127.

Cui, Y., & Zhu, Y. (2014). Curriculum reforms in China: History and the present day. In *Curriculum reforms in China: history and the present day* (pp. 1–6).

Damon, W. (1984). Peer education: The untapped potential. *Journal of Applied Developmental Psychology*, *5*(4), 331–343.

Damon, W., & Phelps, E. (1989). Critical distinctions among three approaches to peer

education. *International Journal of Educational Research*, *13*(1), 9–19.

Dawes, L., Mercer, N., & Wegerif, R. (2004). *Thinking together: A programme of activities for developing speaking, listening and thinking skills for children aged 8-11*. Imaginative Minds.

De Laat, M., Lally, V., Lipponen, L., & Simons, R. J. (2007). Investigating patterns of interaction in networked learning and computer-supported collaborative learning: A role for Social Network Analysis. *International Journal of Computer-Supported Collaborative Learning*, *2*(1), 87–103.

De Wever, B., Schellens, T., Valcke, M., & Van Keer, H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers and Education*, *46*(1), 6–28.

Dekkers, P. J., & Thijs, G. D. (1998). Making productive use of students' initial conceptions in developing the concept of force. *Science Education*, *82*(1), 31–51.

Denny, P., Hamer, J., & Luxton-Reilly, A. (2008). Tools that support contribution-based pedagogies. In *Proceedings of the 9th International Middleware Conference (ACM-IFIP)*.

Denny, P., Hamer, J., Luxton-reilly, A., & Purchase, H. (2008). PeerWise : Students Sharing their Multiple Choice Questions. In *Proceedings of the fourth international workshop on computing education research* (pp. 51–58).

Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process*. MA: Heath.

DfE. (1999). *The National Curriculum: Handbook for primary teachers in England*. London.

DfE. (2013). *The National Curriculum in England: The Complete Framework for Key Stages 1-4*. London.

Ding, X. (2010). *Educational Reform and Development in Shanghai*.

Djung, L. . (1934). *A history of democratic education in modern China*.

Dong, T., Anderson, R. C., Kim, I.-H., & Li, Y. (2008). Collaborative Reasoning in China and Korea. *Reading Research Quarterly*, *43*(4), 400–424.

Dragon, T., Mavrikis, M., McLaren, B. M., Harrer, A., Kynigos, C., Wegerif, R., & Yang, Y. (2013). Metafora: A web-based platform for learning to learn together in science and mathematics. *IEEE Transactions on Learning Technologies*, *6*(3), 197–207. https://doi.org/10.1109/TLT.2013.4

Dringus, L. P., & Ellis, T. (2010). Temporal transitions in participation flow in an

asynchronous discussion forum. *Computers and Education*, *54*(2), 340–349.

Driver, R. (1985). *Children's ideas in science*. McGraw-Hill Education (UK).

Ellis, R., & Goodyear, P. (2013). *Students' experiences of e-learning in higher education: the ecology of sustainable innovation*. Routledge.

Fernández, M., Wegerif, R., Mercer, N., & Rojas-Drummond, S. (2001). Re-conceptualizing "scaffolding" and the Zone of Proximal Development in the context of symmetrical collaborative learning. *The Journal of Classroom Interaction*, *36*(2), 40–54.

Fisher, R. (2013). *Teaching thinking: Philosophical enquiry in the classroom*. A&C Black.

Fosnot, C. T., & Perry, R. S. (1996). Constructivism: A Psychological Theory of Learning. In *Constructivism: Theory, perspectives, and practices* (pp. 8–33).

Fu, H., Chu, S., & Kang, W. (2013). Affordances and Constraints of a Wiki for Primary-school Students? Group Projects. *Educational Technology and Society*, *16*(4), 85–96.

Gao, P. (n.d.). *The rise of education in China through the 20th century*.

Gibson, F. (2007). Conducting focus groups with children and young people: strategies for success. *Journal of Research in Nursing*, *12*(5), 473–483.

Goos, M., Galbraith, P., & Renshaw, P. (2002). Socially mediated metacognition: Creating collaborative zones of proximal development in small group problem solving. *Educational Studies in Mathematics*, *49*(2), 193–223.

Graves, D. H. (1983). *Writing: Teachers and children at work*. Heinemann Educational Books.

Greenhow, C., Gibbins, T., & Menzer, M. M. (2015). Re-thinking scientific literacy out-of-school: Arguing science issues in a niche Facebook application. *Computers in Human Behavior*, *53*, 593–604.

Gu, Q., & Schweisfurth, M. (2006). Who Adapts? Beyond Cultural Models of "the" Chinese Learner. *Language, Culture and Curriculum*, *19*(1), 74–89.

Guiller, J., Durndell, A., & Ross, A. (2008). Peer interaction and critical thinking: Face-to-face or online discussion? *Learning and Instruction*, *18*(2), 187–200.

Gunawardena, C., Hermans, M. B., Sanchez, D., Richmond, C., Bohley, M., & Tuttle, R. (2009). A theoretical framework for building online communities of practice with social networking tools. *Educational Media International*, *46*(1), 3–16.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online

debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, *17*(4), 397–431.

Hamer, J., Luxton-Reilly, A., Purchase, H. C., & Sheard, J. (2011). Tools for contributing student learning. *ACM Inroads*, *2*(2), 78–91.

Hannum, E., & Park, A. F. (2002). Educating China's rural children in the 21st century. *Harvard China Review*, *3*(2), 8–14.

Harper, L. V., & McCluskey, K. S. (2003). Teacher-child and child-child interactions in inclusive preschool settings: Do adults inhibit peer interactions? *Early Childhood Research Quarterly*, *18*(2), 163–184.

He, L. (2003). 上课"主动举手发言与年龄成反比"现象透析 (An analysis of the phenomenon of "students' active disucssion is inversely proportional to their age"). 辽宁省交通高等专科学校学报 (Journal of Liaoning Province Communications College), *2*, 63–64.

Henri, F. (1992). Computer conferencing and content analysis. In *Collaborative learning through computer conferencing* (pp. 117–136). Springer Berlin Heidelberg.

Hiltz, S. R. (1986). The "virtual classroom": Using computer-mediated communication for university teaching. *Journal of Communication*, *36*(2), 95–104.

Horner, S. D. (2000). Using focus group methods with middle school children. *Research in Nursing & Health*, *23*(6), 510–517.

Hou, H. ., Chang, K. ., & Sung, Y. . (2008). Analysis of Problem-Solving-Based Online Asynchronous Discussion Pattern. *Journal of Educational Technology & Society*, *11*(1), 17–28.

Hou, L. (2009). *小学科学网络探究（Science-WebQuest）学习模式的构建与应用 (Construction and application of Science-WebQuest learning model in parimary school)*.

Howe, C., & Mercer, N. (2007). *Children's social development, peer interaction and classroom learning*. *Primary Review, University of Cambridge Faculty of Education*.

Hrastinski, S. (2008). What is online learner participation? A literature review. *Computers and Education*, *51*(4), 1755–1765.

Iordanou, K. (2013). Developing Face-to-Face Argumentation Skills: Does Arguing on

the Computer Help? *Journal of Cognition and Development*, *14*(2), 292–320.

Jeong, A. (2003). The sequential analysis of group interaction and critical thinking in online. *The American Journal of Distance Education*, *17*(1), 25–43.

Jeong, A., & Joung, S. (2007). Scaffolding collaborative argumentation in asynchronous discussions with message constraints and message labels. *Computers and Education*, *48*(3), 427–445.

Jeong, A., & Lee, J. (2008). The effects of active versus reflective learning style on the processes of critical discourse in computer-supported collaborative argumentation. *British Journal of Educational Technology*, *39*(4), 651–665.

Jing, X. (2012). 基于社交网络的高中信息技术教学研究 (Research on the teaching of high school information technology based on social network).

John-Steiner, V., & Mahn, H. (1996). Sociocultural Approaches to Learning and Development-A Vygotskian Framework. *Educational Psychologist*, *31*(3/4), 191–206.

Kamin, C., Glicken, A., Hall, M., Quarantillo, B., & Merenstein, G. (2001). Evaluation of electronic discussion groups as a teaching/learning strategy in the evidence-based medicine course: A pilot study. *Education for Health*, *14*(1), 21–32.

Kang, S., Scharmann, L. C., Noh, T., & Koh, H. (2005). The influence of students' cognitive and motivational variables in respect of cognitive conflict and conceptual change. *International Journal of Science Education*, *27*(9), 1037–1058.

Kapur, M. (2011). Temporality matters: Advancing a method for analyzing problem-solving processes in a computer-supported collaborative environment. *International Journal of Computer-Supported Collaborative Learning*, *6*(1), 39–56.

Kerawalla, L., Petrou, M., & Scanlon, E. (2013). Talk Factory: supporting " exploratory talk " around an interactive whiteboard in primary school science plenaries. *Technology, Pedagogy and Education*, *22*(1), 89–102.

Kolb, D. A. (1984). *Experiential Learning: Experience as The Source of Learning and Development*.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: a review of the research. *Computers in Human Behavior*, *19*(3), 335–353.

Krueger, J., & Zeiger, J. S. (1993). Social Categorization and the Truly False Consensus Effect. *Journal of Personality and Social Psychology*, *65*(4), 670–680. Retrieved

from http://files.clps.brown.edu/jkrueger/journal_articles/krueger-1993-social.pdf

Kruger, A. C., & Tomasello, M. (1986). Transactive discussions with peers and adults. *Developmental Psychology*, *22*(5), 681.

Kuhn, D., Amsel, E., O'Loughlin, M., Schauble, L., Leadbeater, B., & Yotive, W. (1988). *The development of scientific thinking skills*. Academic Press.

Kumpulainen, K., & Mutanen, M. (1999). The situated dynamics of peer group interaction: an introduction to an analytic framework. *Learning and Instruction*, *9*(5), 449–473.

Kuo, P. . (1913). *Reorganization of education under the Republic*.

Lampert, M. D., & Ervin-Tripp, S. M. (1993). Structured coding for the study of language and social interaction. In *Talking data: Transcription and coding in discourse research* (pp. 169–206).

Laurillard, D. (2013). *Rethinking university teaching: A conversational framework for the effective use of learning technologies*. Routledge.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge university press.

Lee, G., Kwon, J., Park, S. S., Kim, J. W., Kwon, H. G., & Park, H. K. (2003). Development of an instrument for measuring cognitive conflict in secondary-level science classes. *Journal of Research in Science Teaching*, *40*(6), 585–603.

Lee, J. ., Yu, Z., Huang, X., & Law, E. . (2016). *Educational Development in Western China:Towards Quality and Equity*.

Levine, L. E., & Munsch, J. (2010). *Child Development: an active learning approach*. Sage.

Li, H., Rao, N., & Tse, S. K. (2012). Adapting Western pedagogies for Chinese literacy instruction: Case studies of Hong Kong, Shenzhen, and Singapore preschools. *Early Education & Development*, *23*(4), 603–621.

Li, L., & Wegerif, R. (2014). What does it mean to teach thinking in china? Challenging and developing notions of "confucian education." *Thinking Skills and Creativity*, *11*, 22–32.

Li, X., Chu, S. K., & Ki, W. W. (2014). The effects of a wiki-based collaborative process writing pedagogy on writing ability and attitudes among upper primary school students in Mainland China. *Computers and Education*, *77*, 151–169.

Liang, Y. (2014). 小学生课堂学习行为的调查研究 (An investigation on classroom learning behavior of students).

Limón, M. (2001). On the cognitive conflict as an instructional strategy for conceptual change : a critical appraisal. *Learning and Instruction*, *11*(4), 357–380.

Limón, M., & Carretero, M. (1997). Conceptual change and anomalous data : A case study in the domain of natural sciences. *European Journal of Psychology of Education*, *12*(2), 213–230.

Lin, H. S., Hong, Z. R., & Lawrenz, F. (2012). Promoting and scaffolding argumentation through reflective asynchronous discussions. *Computers and Education*, *59*(2), 378–384.

Lipponen, L. (2000). Towards Knowledge Building: From Facts to Explanations in Primary Students' Computer Mediated Discourse. *Learning Environments Research*, *3*(2), 179–199. https://doi.org/10.1023/A:1026516728338

Liu, I. M. (1986). Chinese cognition. In *The psychology of Chinese people*.

Liu, N. F., & Littlewood, W. (1997). Why do many students appear reluctant to participate in classroom learning discourse? *System*, *25*(3), 371–384.

Martin, J. (1993). Away from Internalization. In *Contexts for Learning: Sociocultural Dynamics in Children's Development* (p. 254).

Mason, L. (2001). Responses to anomalous data on controversial topics and theory change. *Learning and Instruction*, *11*(6), 453–483.

Mason, R. (1992). Evaluation methodologies for computer conferencing applications. In *Collaborative learning through computer conferencing* (pp. 105–116). Springer Berlin Heidelberg.

McQuaide, S. (2009). Making education equitable in rural China through distance learning. *The International Review of Research in Open and Distributed Learning*, *10*(1).

Mercer, N. (1996). The quality of talk in children's collaborative activity in the classroom. *Learning and Instruction*, *6*(4), 359–377.

Mercer, N., Wegerif, R., & Dawes, L. (1999a). Children's talk and the development of reasoning in the classroom. *British Educational Research Journal*, *25*(1), 95–111.

Mercer, N., Wegerif, R., & Dawes, L. (1999b). Children â€™ s Talk and the Development of Reasoning in the Classroom Children â€™ s Talk and the Development of Reasoning in the Classroom. *British Educational Research Journal*, *25*(1), 95–111.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation: Revised and expanded from qualitative research and case study*

applications in education. John Wiley & Sons.

Mertens, D. M. (2014). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*. Sage publications.

Meyer, K. A. (2004). Evaluating online discussions: Four different frames of analysis. *Journal of Asynchronous Learning Network, 8*(2), 101–114.

Millett, S., & Tapper, A. (2012). Benefits of Collaborative Philosophical Inquiry in Schools. *Educational Philosophy and Theory*, *44*(5), 546–567.

Minocha, S. (2009). Role of social software tools in education: A literature review. *Education And Training*, *51*(5/6), 353–369.

Mogonea, F., & Popescu, A. M. (2015). The Role of Sociocognitive Conflict in Academic-type Learning. *Procedia-Social and Behavioral Sciences*, *180*, 865–870.

Mok, M. M. C., Kennedy, K. J., Moore, P. J., Shan, P. W., & Leung, S. on. (2008). The use of help-seeking by Chinese secondary school students: Challenging the myth of "the Chinese learner". *Evaluation and Research in Education*, *21*(3), 188–213.

Moon, J. A. (2013). *Reflection in learning and professional development: Theory and practice*. Routledge.

Mulder, R. A., Pearce, J. M., & Baik, C. (2014). Peer review in higher education: Student perceptions before and after participation. *Active Learning in Higher Education*, *15*(2), 157–171.

Newman, D. R., Webb, B., & Cochrane, C. (1995). A content analysis method to measure critical thinking in face-to-face and computer supported group learning. *Interpersonal Computing and Technology*, *3*(3), 56–77.

Nguyen, P. M., Terlouw, C., & Pilot, A. (2006). Culturally appropriate pedagogy: the case of group learning in a Confucian Heritage Culture context. *Intercultural Education*, *17*(1), 1–19.

Nield, K. (2004). Questioning the myth of the Chinese learner. *International Journal of Contemporary Hospitality Management*, *16*(3), 189–196.

O'Donnell, A. M., & King, A. (2014). *Cognitive perspectives on peer learning*. Routledge.

O'Hanlon, N., & Diaz, K. R. (2010). Techniques for enhancing reflection and learning in an online course. *Journal of Online Learning and Teaching*, *6*(1), 43–54. Retrieved from http://jolt.merlot.org/vol6no1/ohanlon_0310.htm

OECD. (2010). Shanghai and Hong Kong : Two Distinct Examples of Education

Reform in China. In *Strong Performers and Successful Reformers in Education: Lessons from PISA for the United States* (pp. 83–115). Retrieved from http://wrksolutions.com/employer/education/research/OECD-NCEE-report.pdf

Okada, A., & Shum, S. . (2008). Evidence - based Dialogue Maps as a research tool to investigate the quality of school pupils ' scientific argumentation. *International Journal of Research & Method in Education*, *31*(3), 291–315.

Osborne, J., & Patterson, A. (2012). Authors' response to "For whom is argument and explanation a necessary distinction? A response to Osborne and Patterson" by Berland and McNeill. *Science Education*, *96*(5), 814–817. https://doi.org/10.1002/sce.21034

Pallant, J. (2007). *SPSS survival manual: A step-by-step guide to data analysis using SPSS version 15*. Nova Iorque: McGraw Hill.

Patton, M. Q. (2005). *Qualitative research*. John Wiley & Sons, Ltd.

Pena-Shaff, J. B., & Nicholls, C. (2004). Analyzing student interactions and meaning construction in computer bulletin board discussions. *Computers and Education*, *42*(3), 243–265.

Petrou, M., Kerawalla, L., & Scanlon, E. (2009). The " Talk Factory " software : scaffolding students ' argumentation around an Interactive Whiteboard in primary school science. In *Proceedings of the 9th international conference on Computer supported collaborative learning* (pp. 129–131).

Pfundt, H., & Duit, R. (1988). *Bibliography. Students' alternative frameworks and science education*.

Piaget, J. (1952). *The origins of intelligence in children*. New York: International Univeristy Press.

Piaget, J. (1955). The construction of reality in the child. *Journal of Consulting Psychology*, *19*(1), 77.

Piaget, J. (1985). *The equilibrium of cognitve structures:The central problem of intellectual development*. Chicago: University of Chicago press.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception:Toward a theory of conceptual change. *Science Education*, *66*(2), 211–227.

Prain, V., & Tytler, R. (2012). Learning Through Constructing Representations in Science: A framework of representational construction affordances. *International Journal of Science Education*, *34*(17), 2751–2773.

Rajala, A., Hilppo, J., & Lipponen, L. (2012). The emergence of inclusive exploratory talk in primary students' peer interaction. *International Journal of Educational Research*, *53*, 55–67.

Ratner, N., & Bruner, J. (1978). Games, social exchange and the acquisition of language. *Journal of Child Language*, *5*(3), 391–401.

Reimann, P. (2009). Time is precious: Variable- and event-centred approaches to process analysis in CSCL research. *International Journal of Computer-Supported Collaborative Learning*, *4*(3), 239–257. https://doi.org/10.1007/s11412-009-9070-z

Rice, P. L., & Ezzy, D. (1999). *Qualitative research methods: A health focus*. Melbourne.

Robson, C., & McCartan, K. (2016). *Real world research*. John Wiley & Sons.

Rodriguez, M. A. (2014). Content Analysis as a Method to Assess Online Discussions for Learning. *SAGE Open*, *4*(4).

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence in Education (IJAIED)*, *12*, 8–22.

Salili, F. (2001). Teacher-student interaction: Attributional implications and effectiveness of teachers' evaluative feedback. In *Teaching the Chinese learner: Psychological and pedagogical perspectives* (pp. 77–98).

Sang, G., Valcke, M., Van Braak, J., Tondeur, J., & Zhu, C. (2011). Predicting ICT integration into classroom teaching in Chinese primary schools: Exploring the complex interplay of teacher-related variables. *Journal of Computer Assisted Learning*, *27*(2), 160–172.

Schellens, T., & Valcke, M. (2005). Collaborative learning in asynchronous discussion groups: What about the impact on cognitive processing? *Computers in Human Behavior*, *21*(6), 957–975.

Schon, D. A. (2010). Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. *Australian Journal of Adult Learning*, *50*(2), 448–451.

Schrire, S. (2006). Knowledge building in asynchronous discussion groups: Going beyond quantitative analysis. *Computers and Education*, *46*(1), 49–70.

Schwarz, B. B., Butler, R., Nokes, T., Levine, J., Belenky, D., & Gadgil, S. (2007). Motivation and affect in peer argumentation and socio-cognitive conflict. In

Proceeding of the 9th International Conference of the Learning Sciences (ICLS 2010) (Vol. 2, pp. 211–218).

Schwarz, B. B., & Glassner, A. (2007). The role of floor control and of ontology in argumentative activities with discussion-based tools. *International Journal of Computer-Supported Collaborative Learning*, *2*(4), 449–478.

Shi, L. (2006). The Successors to Confucianism or a New Generation? A Questionnaire Study on Chinese Students' Culture of Learning English. *Language, Culture and Curriculum*, *19*(1), 122–147.

Simon, H. A. (1996). *The sciences of the artificial*. MIT press.

Sit, H. H. W. (2013). Characteristics of Chinese students' learning styles. *International Proceedings of Economics Development and Research*, *62*(8), 36.

Skoumios, M. (2009). The Effect of Sociocognitive Conflict on Students' Dialogic Argumentation about Floating and Sinking. *International Journal of Environmental and Science Education*, *4*(4), 381–399.

Stacey, E., & Gerbic, P. (2003). Investigating the impact of computer conferencing: Content analysis as a manageable research tool. In *Proceedings of the 20th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE)* (pp. 495–503).

Stickel, S. A., & Trimmer, K. J. (1994). Knowing in action: A first-year counselor's process of reflection. *Elementary School Guidance & Counseling*, *29*(2), 102–109.

Strijbos, J. W. (2011). Assessment of (Computer-Supported) Collaborative Learning. *IEEE Transactions on Learning Technologies*, *4*(1), 59–73.

Strike, K. A., & Posner, G. J. (1992). A revisionist theory of conceptual change. In *Philosophy of science, cognitive psychology, and educational theory and practice* (p. 176).

Suthers, D. D. (2006). Technology affordances for intersubjective meaning making: A research agenda for CSCL. *International Journal of Computer-Supported Collaborative Learning*, *1*(3), 315–337.

Suthers, D., & Jones, D. (1997). An architecture for intelligent collaborative educational systems. In *8th World Conference on Artificial Intelligence in Education (AIED'97)* (p. 55).

Swan, K. (2005). A Constructivist Model for Thinking About Learning Online. *Elements of Quality Online Education: Engaging Communities*, *6*, 13–31.

The Design-Based Research Collective. (2003). Design-based research: An emerging

paradigm for educational inquiry. *Educational Researcher*, *32*(1), 5–8.

Topping, K. J., & Trickey, S. (2014). The role of dialog in philosophy for children. *International Journal of Educational Research*, *63*, 69–78.

Turcotte, S. (2012). Computer-Supported Collaborative Inquiry on Buoyancy: A Discourse Analysis Supporting the "Pieces" Position on Conceptual Change. *Journal of Science Education and Technology*, *21*(6), 808–825.

Van Aalst, J., & Truong, M. S. (2011). Promoting Knowledge Creation Discourse in an Asian Primary Five Classroom: Results from an inquiry into life cycles. *International Journal of Science Education*, *33*(4), 487–515.

Veerman, A., & Veldhuis-Diermanse, E. (2001). Collaborative learning through computer-mediated communication in academic education. In *Euro CSCL* (pp. 625–632).

Vonderwell, S., & Zachariah, S. (2005). Factors that Influence Participation In Online Learning. *Journal of Research on Technology in Education*, *38*(2), 213–230.

Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes*. Harvard university press.

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, *53*(4), 5–23.

Wang, S. M., Hou, H. T., & Wu, S. Y. (2016). Analyzing the knowledge construction and cognitive patterns of blog-based instructional activities using four frequent interactive strategies (problem solving, peer assessment, role playing and peer tutoring): a preliminary study. *Educational Technology Research and Development*, 1–23.

Wang, Z. (2011). 小学生课堂上发言不积极的成因及对策思考 (Causes and Countermeasures of inactive students' discussion in Priamry school classroom). 西北承认教育学报 (The Journal of Education Northwest China chengren) , *1*, 66–67.

Watkins, D. A., & Biggs, J. B. (1996). *The Chinese Learner: Cultural, Psychological, and Contextual Influences*.

Watkins, D. A., & Biggs, J. B. (2001). The paradox of the Chinese learner and beyond. In *Teaching the Chinese learner: Psychological and pedagogical perspectives* (pp. 3–23).

Weinberger, A., Clark, D., Erkens, G., Sampson, V., Stegmann, K., Janssen, J., … Fischer, F. (2006). Argumentative knowledge construction in CSCL. *Proceedings of the 7th International Conference on Learning Sciences*, 1094–1100.

Weinberger, A., & Fischer, F. (2006). A framework to analyze argumentative knowledge construction in computer-supported collaborative learning. *Computers and Education*, *46*(1), 71–95.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge university press.

Wertsch, J. V. (1984). The zone of proximal development: Some conceptual issues. *New Directions for Child and Adolescent Development*, *23*, 7–18.

White, J. (2012). Philosophy in Primary Schools? *Journal of Philosophy of Education*, *46*(3), 449–460.

Wolfe, S., & Alexander, R. J. (2008). Argumentation and dialogic teaching: Alternative pedagogies for a changing world. *Beyond Current Horizons*.

Wong, J. K. K. (2004). Are the learning styles of Asian international students culturally or contextually based? *International Education Journal*, *4*(4), 154–166.

Xie, Y., Ke, F., & Sharma, P. (2008). The effect of peer feedback for blogging on college students' reflective learning processes. *The Internet and Higher Education*, *11*(1), 18–25.

Yang, S. H. (2009). Using blogs to enhance critical reflection and community of practice. *Educational Technology and Society*, *12*(2), 11–21.

Yang, Y. (2016). Lessons learnt from contextualising a UK teaching thinking program in a conventional Chinese classroom. *Thinking Skills and Creativity*, *19*, 198–209.

Yang, Y., Crook, C., & O'Malley, C. (2014). Can a social networking site support afterschool group learning of Mandarin? *Learning, Media and Technology*, *39*(3), 267–282.

Yang, Y. F. (2010). Students' reflection on online self-correction and peer review to improve writing. *Computers and Education*, *55*(3), 1202–1210.

Yiong-Hwee, T., & Churchill, D. (2007). Using Sentence Openers to Support Students' Argumentation in an Online Learning Environment. *Educational Media International*, *44*(3), 207–218.

Zhang, J., Scardamalia, M., Lamon, M., Messina, R., & Reeve, R. (2007). Socio-cognitive dynamics of knowledge building in the work of 9- and 10-year-olds. *Educational Technology Research and Development*, *55*(2), 117–145.

Zhao, N., & McDougall, D. (2008). Cultural Influences on Chinese Students' Asynchronous Online Learning in a Canadian University. *International Journal of E-Learning & Distance Education, 22*(2), 59–80.

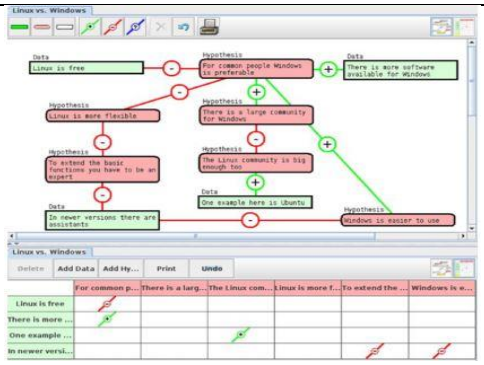
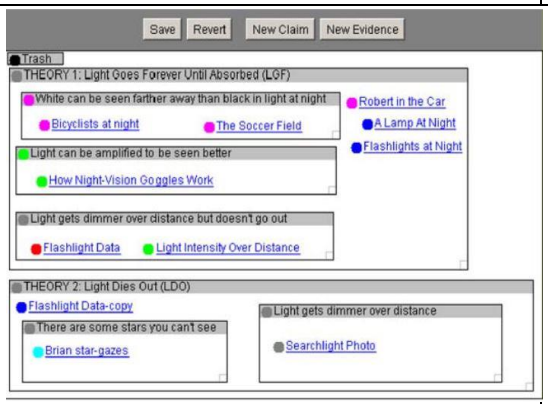
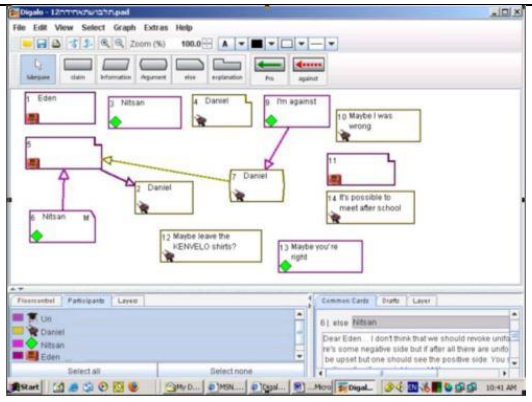
Zhou, Y., Knoke, D., & Sakamoto, I. (2005). Rethinking silence in the classroom: Chinese students' experiences of sharing indigenous knowledge. *International Journal of Inclusive Education, 9*(3), 287–311.

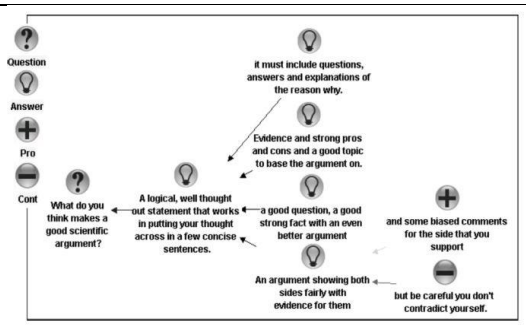
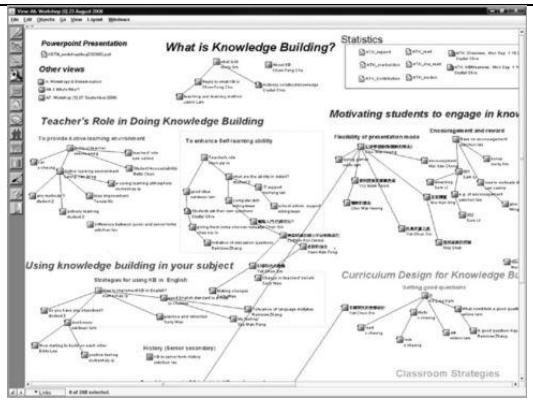
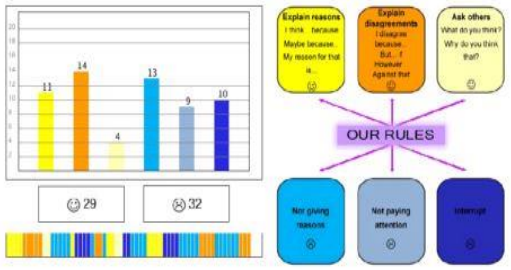
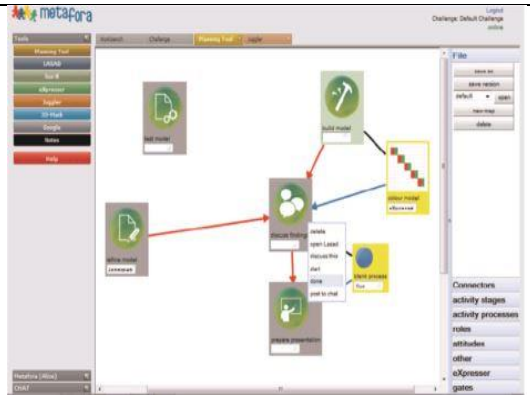
Zhu, C., Valcke, M., & Schellens, T. (2010). A cross-cultural study of teacher perspectives on teacher roles and adoption of online collaborative learning in higher education. *European Journal of Teacher Education, 33*(2), 147–165.

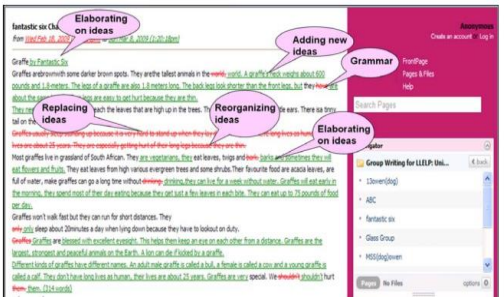
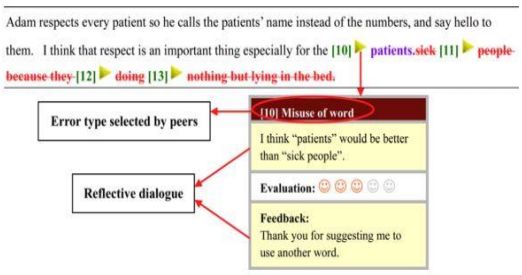
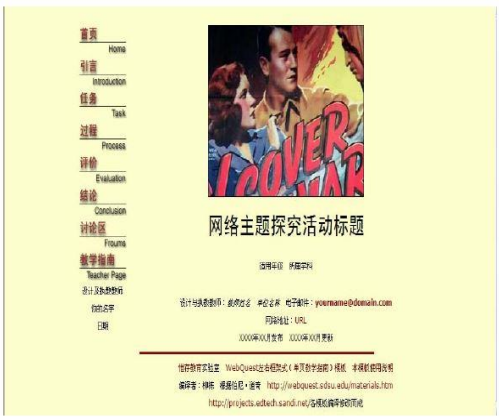
Zhuang, W., & Lai, Y. (2002). The current situation and countermeasure in minority nationality region—case study of Yunnan, Guizhou & Sichuan Provinces. *Journal of Southwest University of Nationalities*, 21–31.

11 Appendix

11.1 Appendix I: Summary of technology supported collaborative learning/argumentation system

Technology	Key characteristics	Interface of system	Relevant studies
Belvedere	• Multiuser • Knowledge representation tool • Visualization • Analysis • Feedback		Suthers et al. (2001)
SenseMaker	• Individual or multiuser in front of one computer • Knowledge representation tool • Visualization • Inquiry based activity		Bell (1997)
Digalo	• Multiuser • Discussion-based tool • Visualization • Co-creating • Co-construction of knowledge		Schwarz and Glassner (2007)

Evidence-based dialogue map	• Multiuser • Discussion-based tool • Inquire-based activity • Visualization of argumentative dialogue • Co-creating • Co-construction of knowledge		Okada & Shum (2008)
CSILE/ knowledge forum	• Generate questions • Discussion-based tool • Visualization • Co-construct explanation • Revise ideas		Lipponen (2000) Scardamalia et, al (1989) Carol K K Chan (2011,2012)
Talk Factory	• Multiuser • Discussion-based tool • Visualization of the ground rule • Co-construction of knowledge		Petrou, Kerawalla &Scanlon (2007)
Metafora	• Multiuser • Discussion based tool • Web-based platform • Inquiry based activity • Co-creating • Co-construction of knowledge		Dragon, Mavrikis& McLaren (2013)
Blog (Blogger)	• Share knowledge • Receive feedback • Derive social support from each other	None	(Wang, Hou, & Wu, 2016) (Yang, 2009)

Wiki	• Collaborative editing • User generated content enabling sharing • Co-creating • Co-construction of knowledge		(Li, Chu, & Ki, 2014) (Fu, Chu, & Kang, 2013) Woo et al.'s (2011)
Online text construction system	• Trace result • Interactive • Peer review • Based on social constructive theory		(Yang, 2010)
WebQuest	• Inquiry-led • Upload information • Sharing finding		(Hou, 2009)
Social network sites (e.g. Facebook)	• Learning through interaction and participation • Shared interests and information	 Top: (1) Picture header, title, and main tabs linking personal pages including personal blogs, music and video collections, photo albums and comment wall. Left: (2) Photos by all the members (3) A real-time dynamic activity feed of the whole network Middle: (4) Discussions in the public forum Right :(5) User information, (6) A list of members link to personal pages, (7) Event list to keep track of attendance, (8) BBC News Feeds	(Yang, Crook, & O'Malley, 2014) (Greenhow, Gibbins, & Menzer, 2015)

11.2 Appendix II: Research Consent Forms to Chinese schools

In order to complete this research, three studies were conducted to collect Chinese younger students' data in Chinese schools. Consent forms were designed to explain the aim of the study and how the study would be conducted. Additional, consent forms stated that all data collected from the observation studies and interview would be confidential and anonymous. Furthermore, the participants or the participant's parents have the right to withdraw from the study at any time should they wish to do so. The data will be stored in accordance with the Data Protection Act. No children will be identifiable from the data and the data will only be used for the purpose of this research.

All three consent forms were sent to head teachers of Chinese schools being studied and were got permit from the schools. Additional, the head teacher helped to explain this experiment to parents of these students and got permit from parents to collect data from younger students. The following documents attached to prove it.

学生为中心的讨论模式行为研究
Learning behaviour observation in student-led discussion
（第一期实验：课堂实验）
(Fist study: face-to-face learning environment)

这是英国诺丁汉大学博士研究项目。这个博士研究项目是关于如何设计新的学习模式通过计算机的支持从而给予学生更多提出自己的问题和同别的同学进行交互性的讨论学习的机会，并且这样学习模式可以被中国老师所接受。研究项目的目标群体是小学三年级到五年级。这次研究属于博士研究项目的第一期，其主要目的是探究中国学生是否会自愿参与并且表现出不同的交互反应当他们在以学生为中心的讨论学习模式的时候。这次的研究会涉及到研究者观察学生们在这个学习模式中的参与度以及他们的交互反应当他们同别的不同学生进行讨论交互的时候。研究的结果将会贡献到总结中国学生在不同的学习模式下的参与度以及反应，这个反应和交互度可以暗示是否中国学生愿意接受这样的学习模式以及他们的反应行为是否可以一定的程度避免错误信息的分享。同时这个研究结果也会贡献到以学生为中心的学习平台的开发和设计当中。这次的研究主要是基于课堂形式的讨论。

基于课堂形式的讨论首先是为了观察当学生们是否愿意自发的提问以及回答问题，其次是观察在讨论过程中接收到别的同学回答的不同的信息时，学生们会有什么样的不同反应。植物的生长会作为这次讨论的主题，让学生自己设计对植物生长感兴趣的问题，并且每组学生派一个代表起来提问。每个学生可以自由的对这个问题发表自己不同的答案，同时他们也可以针对别人的答案进行发表自己不同的观点。整个实验过程大约一堂课 40 分钟。

为了更好的分析孩子的反应和行为当他们遇到错误和分歧答案的时候，录像将会被使用在整个实验过程中。这些数据的收集是为了分析和回答实验目的。所有的数据都会安全放好，并且在博士研究结束之后销毁。如果任何家长想了解更多关于我研究的内容或者是涉及到孩子实验过程中数据问题，都可以联系我或者我的导师，我们的详细地址：

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所有参加实验研究孩子们的数据都会根据数据保护协议 1998 妥善安全的存储好。所有的数据仅有这个项目的研究人员可以使用。 同意书将会发给各位家长/监护人，同时如果家长对这个实验过程有任何异议，可以随时发邮件联系我鲍雯雯把您孩子的实验数据全部抹掉。

所有的数据在公布之前都会佚名，如何有特别家长愿意同意让自己的孩子在数据公布的时候不佚名，可以填写额外同意书。公布信息是指发表在学术的会议和期刊上，任何人可以通过网络查看这些相关的学术文献。这样是为了更好的理解如何利用科技去帮助孩子们获取正确的信息同时让孩子有辩证性的思维去拒绝错误的信息当他们在分享知识和讨论的时候。

英国诺丁汉大学计算机学院研究部已经通过并且承认了这个研究项目。

Wenwen Bao (研究员)  2014.11.20

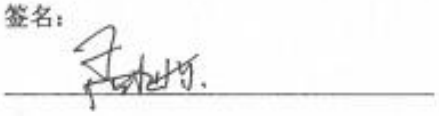
学生为中心的讨论模式行为研究（课堂实验）
同意表格

这是用来确认学校同意学生参加这个研究。学校已经仔细阅读了所有相关的信息并且理解会涉及到的实验内容。

学校理解可以随时通知研究者提出抹去学生的实验数据如果当学校对这个实验有异议的时候。

学校允许所有学生的实验数据可以被采集用作这个项目的研究。并且告知家长相关实验内容，同时已经得到了家长的认可。

签名：



学校名字：

杭州市建兰小学

时间：

2014.11.20

学生为中心的讨论模式行为研究（课堂实验）
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签名：陈善明

学校名字：杭州市实验外国语学校

时间：2014.11.20.

学生为中心的讨论模式行为研究（课堂实验）
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签名：

周世纪、蔡玲玲

学校名字：

杭州市文海实验学校

时间：

2016.11.20

学生为中心的讨论模式行为研究
Learning behaviour observation in student-led discussion
（第二期实验：计算机支持实验）
(The second study: computer supported student –led discussion in class)

这是英国诺丁汉大学博士研究项目。这个博士研究项目是关于如何设计新的学习模式通过计算机的支持从而给予学生更多提出自己的问题和同别的同学进行交互性的讨论学习的机会，并且这样学习模式可以被中国老师所接受。研究项目的目标群体是小学三年级到五年级。这次研究属于博士研究项目的第二期，根据研究项目第一期的实验结果，设计了基于以学生为中心的学习平台，同时也发现了在课堂开展以学生为中心讨论模式的局限性。第二期的项目研究主要的目的就是让学生参与计算机支持的以学生为中心的讨论交互模式，从而进行对比学生在网络学习平台所产生的不同的显著交互反应。从而更好的验证网络学习平台对学生学习的影响。研究的结果将会贡献到分析和了解网络学习平台对中国学生在参与度还有交互度方面的影响，从而验证这样的学习方式是否适合中国学生并且在一定的程度避免错误信息的分享。这次的研究主要分成两部分：第一部分是基于计算机支持的讨论，第二部分涉及后续的面试。

第一部分基于计算机支持学生为中心的讨论模式是为了观察中国学生在计算机支持下的网络学习平台中的表现，主要是观察他们的参与度以及交互度。整个讨论模式和第一期的研究项目基于课堂的讨论模式相似，但是这次的实验是基于计算机，并且引入不同年级的学生一起参与讨论。讨论的过程中仍旧采取植物生长的科学话题，让他们对自己好奇的植物生长话题提出问题，并且自发的参与讨论。整个实验的过程大约一节课的时间 40 分钟。

第二部分研究是为了更好的了解这个网络学习平台对学生的影响。通过采取面试的形式，更加深入的了解网络平台设计的三个按键对他们交互行为的影响，以及他们如何评价和分析这个网络学习平台对他们学习的影响，最后让他们对这个网络学习平台和他们平时通过网络学习知识的平台进行比较和分析。

为了更好的分析学生在交互过程的行为，他们在网络平台上所留下的信息都会被保存并且进行数据分析。同时录音也会在之后的面试过程中使用用于获取数据利于分析。所有的数据都会安全保存，并且在博士研究结束之后销毁。如果任何家长想了解更多关于我研究的内容或者是涉及到孩子实验过程中数据问题，都可以联系我或者我的导师，我们的详细地址：

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所有的数据在公布之前都会佚名，如何有特别家长愿意同意让自己的孩子在数据公布的时候不佚名，可以填写额外同意书。公布信息是指发表在学术的会议和期刊上，任何人可以通过网络查看这些相关的学术文献。这样是为了更好的理解如何利用科技去帮助孩子们获取正确的信息同时让孩子有辩证性的思维去拒绝错误的信息当他们在分享知识和讨论的时候。

英国诺丁汉大学计算机学院研究部已经通过并且承认了这个研究项目。
Wenwen Bao

（研究员） 2015.5.4

学生为中心的讨论模式行为研究（计算机支持实验）同意表格

这是用来确认学校同意学生参加这个研究。学校已经仔细阅读了所有相关的信息并且理解会涉及到的实验内容。

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签名：

学校名字：

时间：2015.5.4

学生为中心的讨论模式行为研究（计算机支持实验）
同意表格

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签名：陈善明

学校名字：杭州市实验外国语学校

时间：2015.5.4.

学生为中心的讨论模式行为研究（计算机支持实验）
同意表格

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签名：

学校名字：

杭州市康桥小学

时间：

2015.5.4

学生为中心的讨论模式行为研究
Learning behaviour observation in student-led discussion
（第三期实验：计算机支持应用实验）
(The third study: application of technology supported discussion)

这是英国诺丁汉大学博士研究项目。这个博士研究项目是关于如何设计新的学习模式通过计算机的支持从而给予学生更多提出自己的问题和同别的同学进行交互性的讨论学习的机会，并且这样学习模式可以被中国老师所接受。研究项目的目标群体是小学三年级到五年级。这次研究属于博士研究项目的第三期，其主要目的就是了解和探索如何将前两次研究设计的网络学习平台可以应用于中国教育背景并且被老师所接受。这次研究主要分成三部分：第一部分是老师的面试，第二部分是观察实验关于计算机支持交互式学习的实际应用，第三部分是观察实验之后的老师以及学生的面试。

第一部分是老师的面试。这次面试的目的是基于老师角度分析这个网络平台所能带给老师以及学生学习的好处，其结果可以贡献到计算机支持交互学习网络平台的应用设计。

第二部分是观察实验：网络学习平台同传统课堂教学的结合，从而验证这样的应用设计是否有利于学生学习以及老师授课。整个实验在课后进行，老师根据下一阶段将要上的课程内容，先在网络平台发布课后作业，让学生先进行讨论，然后再结合学生的讨论结果反馈到实际的课堂授课过程。

第三部分是老师和学生的面试。根据观察实验的进行，为了更好的了解这样的应用对学生学习经历以及老师教学经历的影响，从而通过的面试的方式进行深入的了解。

为了更好的获取信息达到实验目的，面试的内容都会通过录音进行录制，然后进行数据分析。观察实验的数据也会被保存，用于数据分析。所有的数据都会安全放好，并且在博士研究结束之后销毁。如果任何家长想了解更多关于我研究的内容或者是涉及到孩子实验过程中数据问题，都可以联系我或者我的导师，我们的详细地址：

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所有参加实验研究孩子们的数据都会根据数据保护协议 1998 妥善安全的存储好。所有的数据仅有这个项目的研究人员可以使用。 同意书将会发给各位家长/监护人，同时如果家长对这个实验过程有任何异议，可以随时发邮件联系我鲍雯雯把您孩子的实验数据全部抹掉。

所有的数据在公布之前都会佚名，如何有特别家长愿意同意让自己的孩子在数据公布的时候不佚名，可以填写额外同意书。公布信息是指发表在学术的会议和期刊上，任何人可以通过网络查看这些相关的学术文献。这样是为了更好的理解如何利用科技去帮助孩子们获取正确的信息同时让孩子有辩证性的思维去拒绝错误的信息当他们在分享知识和讨论的时候。

英国诺丁汉大学计算机学院研究部已经通过并且承认了这个研究项目。

Wenwen Bao
(研究员)

2015.10.5

学生为中心的讨论模式行为研究（计算机支持应用实验）

同意表格

这是用来确认学校同意学生参加这个研究。学校已经仔细阅读了所有相关的信息并且理解会涉及到的实验内容。

学校理解可以随时通知研究者提出抹去学生的实验数据如果当学校对这个实验有异议的时候。

学校允许所有学生的实验数据可以被采集用作这个项目的研究。并且告知家长相关实验内容，同时已经得到了家长的认可。

签名：

学校名字：

杭州市文海实验学校

时间：

2015.10.5

学生为中心的讨论模式行为研究（计算机支持应用实验）

同意表格

这是用来确认学校同意学生参加这个研究。学校已经仔细阅读了所有相关的信息并且理解会涉及到的实验内容。

学校理解可以随时通知研究者提出抹去学生的实验数据如果当学校对这个实验有异议的时候。

学校允许所有学生的实验数据可以被采集用作这个项目的研究。并且告知家长相关实验内容，同时已经得到了家长的认可。

签名：陈盖明

学校名字：杭州市实验外国语学校

时间：2015.10.5.

学生为中心的讨论模式行为研究（计算机支持应用实验）

同意表格

这是用来确认学校同意学生参加这个研究。学校已经仔细阅读了所有相关的信息并且理解会涉及到的实验内容。

学校理解可以随时通知研究者提出抹去学生的实验数据如果当学校对这个实验有异议的时候。

学校允许所有学生的实验数据可以被采集用作这个项目的研究。并且告知家长相关实验内容，同时已经得到了家长的认可。

签名：

学校名字：

杭州市[illegible]小学

时间：

2015.10.5

11.3 Appendix III: third study document for students to read

Third study document

This study will record your comments posted on the website but that the names of all participants will remain anonymous. All data collected from the study will remain strictly confidential, which means that only researcher willable to review it and that any comments or questions quoted as part of the research and findings will also remain anonymous. If at any time during the study, you wish to delete the questions you posted or comments you contributed, please feel free to do it. The researchers' contact information such as name and email are included at the end of this document. If you want to withdraw any information, you should contact researcher.

本次实验会记录你在网络上交互所留下的问题以及留言，但是你的用户名都会保持佚名的形式。所有在本次实验中所采集的数据都会高度保密，这意味着只有研究者才可以去看他。同时你们在网络上留下的任何留言和问题在以后的引用中也会以佚名的形式出现。如果你在实验中的任何时候想要删除你自己提过的问题，或者留过的言论，请随意，同时研究者也会在这个文件的末尾留下自己的联系方式。如果任何时候你想要退出实验，你可以联系研究者。

The aim of this study is to ask you to answer the homework question and interact with others by using the technology supported student-led discussion tool. Please use the 360 security browser to log in to the website www.wztsuo.com. The login page of this website is shown as figure 1. Please input your username and password to login (the details about your username and password have already been provided to you by your teachers).



图一： 网站首页(figure 1: login page)

After you log in to the website, the main page will be displayed as shown in figure 2. There are two main tasks for you in this study. In the first task, please click the task section to view the homework questions posted for you by the science teacher. Within each question's title you will also see an explanation for this question is available for

students showing which school and which year they are from (see figure 3). If you know the answer to the questions, please post your answers to the homework question, when you have answered your schools' questions, you can also read the questions for other schools as well as different year's questions.

登入网站后会出现如图二所示的样子。然后点击进入必读区，必读区里面有老师所布置的作业。每个人把自己知道的答案填写上去。这里每个问题后面会标明是什么学校哪个年级的家庭作业，找到相应的问题进行回答。回答完毕以后同时也可以看别的学校的家庭作业。



图二：登入后页面显示 (figure 2: main page after login to the website)



图三：必读区详细问题 (figure 3:questions in task section)

When you read the other students' questions and answer the questions, please click the Question & Answer section. You can ask any questions relating to topic from science book (any topic or subject you did not understand or are curious about). Figure 4 showed

the page of the Question & Answer section. You can click button titled “ask a question” when you would like to ask a question.

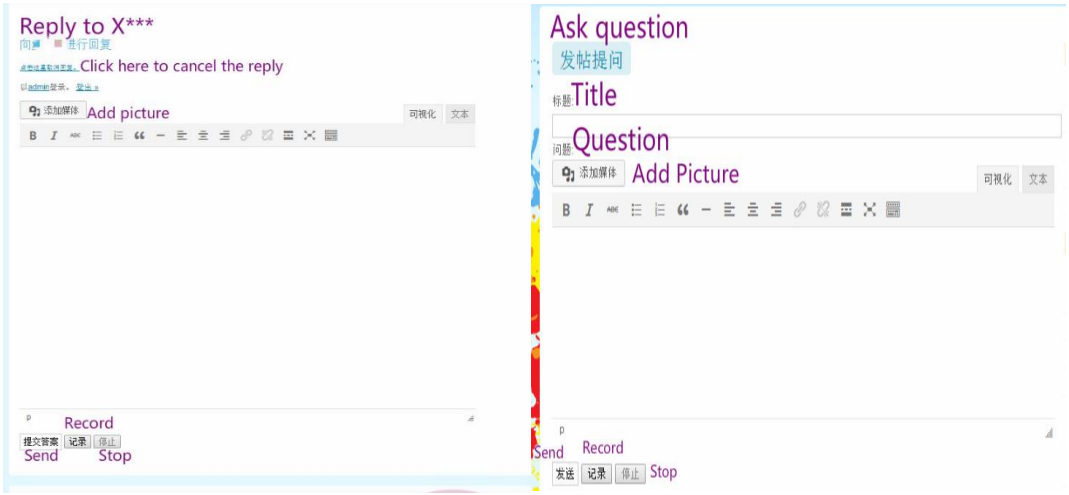
当你回答好家庭作业的问题以及别的学校的问题以后，你点击进入 问题&回答中，可以发表关于科学课“形状与结构”相关的问题（你不理解的，或者你好奇的地方的）。



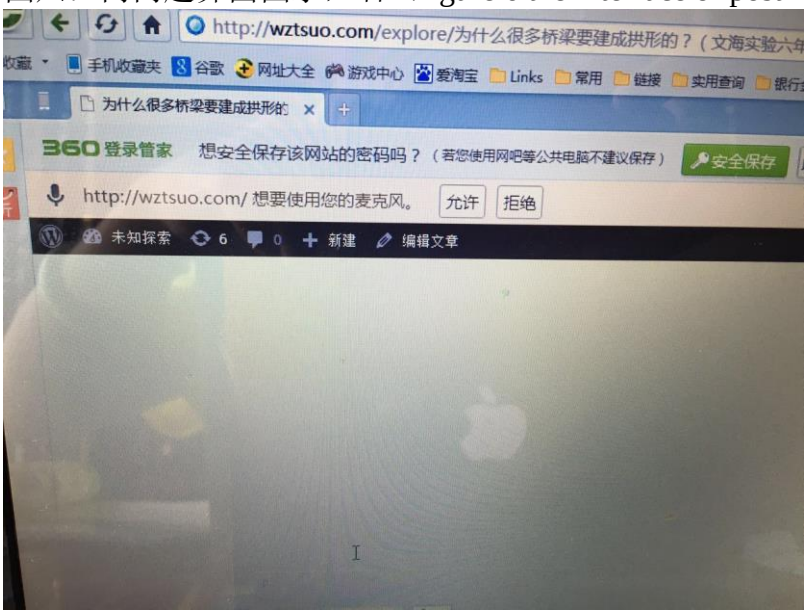
图四：问题&回答页面发表相关问题

小贴士：
上次电脑教室做实验有个功能大家没有用就是语音功能。这里如果大家觉得打字太慢可以使用语音功能。在图五和六所展示的都是问问题和留言的界面，在这个界面里有一个录音按键和停止按键。点击录音就是开始录音，点击停止就是停止录音。点击录音的时候有些浏览器会上面跳出以下图示 7，只要点击允许，这样就可以使用麦克风了。有些浏览器或者电脑不支持，那么同学们就继续使用打字的功能。

Tip:
If you have any difficulties answering a question; for example, you find it too difficult or slow to type, then you can use the audio function. Figure 5 is the interface for posting comments and figure 6 is the interface for asking a question. in the interface of both figure 5 and 6 there is a button called “record” and a button called “stop”. These two buttons are designed to record audio rather than typing in the text. When you try to record audio, you can click the button to record, a sentence will pop up on screen to ask whether the wztsuo.com website can use your microphone. Please click the “Accept” button (shown in figure 7). When you finish recording, please click to the “stop” button and then click on “submit”.



图五：留言界面图示，左（Figure 5 the interface of posting comments，left）；
图六：问问题界面图示，右（figure 6 the interface of posting questions ,right）



图七：关于录音提示的信息（Figure 7 information about audio recording ）

最后非常感谢同学们参与本次实验！
Finally, thanks you for attending this study.

我的联系方式:
鲍雯雯, psxwb2@nottingham.ac.uk
My contact information:
Wenwen Bao, psxwb2@nottingham. ac.uk

11.4 Appendix IV: Questionnaire for personal experience of online student-led discussion tool

Thank you for attending this part of the study which is the questionnaire. The aim of this part of the study is to evaluate the online student-led discussion tool that you used in the second study based upon the five aspects of participation, interaction, learning experience and motivation.

All data collected from the study will remain strictly confidential, this means that only the researcher is able to review the responses and that any comments or questions quoted as part of the research findings will remain anonymous. If at any time during the study you wish to delete the questions you have posted or comments you have contributed, please feel free to do it. The researchers' contact information such as name and email is included in this document. If you wish to withdraw any information, you can contact researcher. My contact details are : Wenwen Bao, psxwb2@nottingham. ac.uk.

1. General information

Please choose your school and year

Which school are you in ?

A. *School A*
B. *School B*
C. *School C*

Which year are you in ?

A. *Year 3*
B. *Year 4*
C. *Year 5*

The username you login is _____

2. *Aspects of personal experience*

Aspects of personal experience	1(Strongly disagree)	2(disagree)	3 (Neutral)	4(agree)	5(Strongly agree)
I participated in the discussion	1	2	3	4	5
I had opportunity to express myself	1	2	3	4	5
Students reacted to my contribution	1	2	3	4	5
I reacted to other students' contribution	1	2	3	4	5
I felt that I learned new things after the discussion	1	2	3	4	5
The discussion caused me to think about this subject	1	2	3	4	5
I was interested in this topic	1	2	3	4	5
I enjoyed the discussion	1	2	3	4	5

11.5 Appendix V: Published paper

THE EFFECTIVENESS OF FACE-TO-FACE DISCUSSION IN CHINESE PRIMARY SCHOOLS

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University of Nottingham (UNITED KINGDOM)

Abstract

This paper reports on a study of learning behavior in Chinese children aged 8-11 years. Current educational settings in China sit within the Confucian cultural background; teaching is didactic with the teacher taking an authoritarian role and children learning by listening and doing but not by questioning. The use of purely didactic teaching can impose limitations to learning due to the reduced opportunity to engage in peer-to-peer discussions and thus cognitive conflict situations which could otherwise enable scaffolding of learning. This research aimed to investigate the limitations within the Chinese classroom and to study the behaviour of children when interacting in peer-to-peer discussions with a view to understanding how to augment their learning to promote more active learning and a deeper understanding of taught material.

Three primary schools in China took part in the study and a total of 378 children were observed taking part in face-to-face discussions in groups with no teacher present. The children were instructed to think, in their groups, of questions regarding a particular science topic and then to put these questions to other groups. The interactions between the children were recorded and thematically analyzed to determine types of responses and patterns between responses. These were then statistically analyzed and a model of question-answer responses was developed. It was established, from this model that the responses observed relate to existing models of peer interaction developed by other researchers and the sessions encouraged reasoned dialogue between peers. However there were indeed limitations to the types of responses between peers which reflected reduced critical thinking and engagement with conflict. It is proposed that the use of technology to bridge gaps in the model and thereby enhance critical thinking and cognitive conflict would enable more productive discussion in the classroom with reciprocal exploration of reasoning and viewpoints. Such discussion should incorporate agreement and cooperation but also disagreement and conflict between peers without loss of "face" and would actively promote knowledge building and deeper learning.

Keywords: Cultural effects, peer interaction, cognitive conflict, Chinese children.

1 INTRODUCTION

It is well regarded that active learning promotes a deeper understanding of taught material ([1], [2], [3], [4], [5]). Pupils who engage with material through questioning and interacting with others can build on their knowledge through the process of scaffolding. During this process common understanding is promoted through discussion and arguing enabling pupils to share knowledge and question others' understanding and ultimately correct and build on their own knowledge. However the opportunity to take part in this style of learning can depend not only on the teachers and environment but also on the learning culture that is present.

In China there is a strong culture of Confucianism which promotes didactic learning ([6]) in that pupils are expected to learn by listening and doing with the teacher taking an authoritarian role. The relationship between student and teacher is strongly hierarchical ([7], [6], [8]). Pupils, whilst being well behaved and showing respect towards their teacher, are encouraged not to question the teacher or each other but to learn passively by rote ([9], [10]). Therefore students often uncritically accept information without being required to question it or think more deeply. This discourages students in presenting their own thoughts, in order to "save face" and their understanding of the subject may be limited ([11], [12]). Whilst this method enables exams to be passed, it does not promote deep learning.

However literature on cultural influences within the Chinese classroom is sparse ([13], [14]) and little is known about how younger Chinese children (aged 8-11 years) behave in the classroom during face-to-face teaching. This research aimed to investigate this environment to observe how pupils interact when given the opportunity to question and scaffold each other's learning and to examine behavioural patterns which emerge from the data with a view to designing interventions to promote deep learning strategies.

2 BACKGROUND

Well known theories put forward by Piaget and Vygotsky ([15], [16]) explain the process of peer interaction as one which enables continual refinement of cognitive processes over time, both intellectually and socially. Learners gain a deeper understanding of material through discussion and explanations and offering forward alternative viewpoints that can push other learners to reflect on their own knowledge ([18], [19]). Thus this reciprocal process promotes a symbiosis of assimilation and accommodation which is influenced by prior knowledge and experience ([15], [18]). The danger is that peers will develop a misconception of the topic being discussed. However, ultimately, this will lead to disequilibrium between a pupil's existing internal schema and the new knowledge with which they are confronted and therefore it will promote cognitive conflict ([3], [4], [19], [20]).

There is evidence within the research field that cognitive conflict can led to conceptual change, although in older subjects (13-14 years and Undergraduate students([20], [21], [22]). However there are a number of limitations to this ([20], [23], [24]). Firstly an individual's prior knowledge and experience is vitally important. If they have little or no knowledge then there is unlikely to be a cognitive conflict ([15],[21]) and therefore they are more likely to assimilate the new (possibly incorrect) information without questioning ([22]). Secondly the degree to which conflicting information promotes cognitive change depends on how the information is given. If it is given passively then little or no cognitive change is likely to occur but if the individual is given, and takes, an opportunity to question it and discuss with others they are more likely to experience cognitive change ([21]). The learner's reaction to the conflict therefore has a bearing on its effect. Learners who passively accept the new information, even in an environment promoting discussion, are less likely to gain conceptual change than compared with those who question, argue, test and negotiate their understanding with others ([5], [21], [25]).

There are existing models in the literature that have been used to analyze peer interaction ([26], [27], [28], [1], [29]). The Critical Thinking Model proposed by Gunawardena ([29]) for example, focuses on the analysis of online debate in which they defined online debate as a co-creation of knowledge and negotiation of meaning (See Fig. 4, right side). The model consists of five phases: I) sharing or comparing information, II) dissonance or inconsistency, III) negotiating what is to be agreed (and where conflicts exist) or co-construction, IV) testing tentative constructions and V) statement or application of newly constructed knowledge. This model encapsulates the process described above of taking information and assimilating new knowledge based on resolving any cognitive conflict between the new knowledge and the individual's prior knowledge and experience.

Ultimately, promoting cognitive conflict is a powerful tool for enhancing assimilation of new knowledge and deeper learning ([20], [24]). The research reported in this paper aims to examine if, and how, cognitive conflict arises in the Chinese classroom, given the strong culture of Confucianism.

3 RESEARCH QUESTIONS

In order to investigate peer interaction as an approach to learning in the Chinese classroom there needs to be an understanding of when and how cognitive conflict might arise and the reactions that follow this. Cognitive change requires certain reactions within and between pupils to occur so that they engage with a more dynamic process of exploring the topic ([22]).

The following research questions have thus been developed:

RQ1: Will Chinese pupils aged 8-11 years actively join the discussion when a student centered interaction is conducted in a Chinese face-to-face classroom?

RQ2: What types of responses are most likely to occur in a peer-to-peer question and answer Chinese face-to-face learning environment?

RQ3: Which of the possible responses given by children are statistically significant and are any significant response patterns revealed in a Chinese peer-to-peer question and answer learning environment?

RQ2 aims to enable the researcher to determine what types of responses lead children to deeper thinking and whether children show their different answers when confronted with information that conflicts with their own understanding. RQ3 looks at whether a significant pattern of responses emerges and enables the researcher to investigate whether these might benefit or complement existing models of interaction found in the literature.

In order to answer these research questions a study was conducted in three Chinese schools whereby pupils took part in face-to-face discussions, as described in the next section.

4 METHODOLOGY

4.1 Participants

A total of 378 children (163 girls, 215 boys) aged 8 to 11 years (years 3 to 5) took part in the study from three primary schools in China. Two of these schools are public schools (ranked "outstanding" and "good" respectively) and one is a private school (ranked "good") in Hangzhou, Zhejiang, China. Pupils took part in a discussion on a science topic lead by the researcher, without the involvement of their teacher.

4.2 Procedures

In the classroom children were assigned to groups of 4 and took part in a 40 minute session where they engaged in a discussion about the development and growth of plants. Each session consisted of one year group resulting in a total of 9 sessions (3 per school.) The session began with the researcher giving each group a pencil and paper and asking them to write down all the information they knew about plant growth. Children were encouraged to write this on leaf-shaped paper which they then attached to a picture of a plant. Following this children were asked to write down at least three questions reflecting their curiosity on the growth of plants. After 10 minutes of discussion, one child representative from each group was asked to pose a question to children from the other groups. Children knowing the answer were encouraged to stand up to answer the question. No help with questions or answers was given by the researcher or teacher (who remained silent throughout). Therefore all questions and answers were considered spontaneous.

Questions and answers were audio recorded and transcribed before conducting a thematic analysis. Jeong's ([1]) event categories were used in the content analysis with some adaptation according to the research purpose. The unit of analysis was the unit of meaning([27]), consisting of sentences or phrases. Using a grounded theory approach, eleven categories were identified: *Answering (ANS), Alternative Answer (ALA), Extending (EXT)* (extend and complement another's answer), *Agreement (AGR), Disagreement (DIS), Evaluation (EVA)* (judging accuracy, validity, importance of an answer), *Inspiration (INS)* (as shown from other's answers), *Question Complement (QUC)* (adding more information to a question), *Questioning (QUE)* (querying another's answer), *Requesting (REQ)* (asking for more information), and *Summary (SUM)* (reviewing or summarizing points raised). These categories enabled the classification of responses so that information conflict relative to current understanding could be identified as well as levels of understanding and misconceptions. Further to this, observations noted the responses that were given in situations of conflict between the pupils (e.g. when disagreement occurred or different viewpoints were put forward) versus responses given in situations of no conflict.

Responses were coded manually using NVivo to calculate code frequencies. Normally, the first set of answers to a question was coded as *Answering*. In order to analyse consecutive behaviours the frequency of each behavioural category (referred to as the *target code*) immediately following another behavioral category (the *given code*) was calculated using Bakeman & Gottman's ([30]) Sequential Analysis method. This is a commonly used method in this domain ([31]). For example an initial behavior such as *Question (given code)* was commonly observed to be followed by a behavior of *Answer (target code)* but may also be followed by an *Alternative Answer* or an *Evaluation*. The purpose of this analysis was to reveal the significant pattern of Chinese children's interaction which highlight the types of responses that would help children to discuss and think more deeply. The formulae used are shown in Fig. 1 below.

$$m_{GT} = \frac{x_{+T}}{x_{++}} x_{G+} = \frac{x_{G+} x_{+T}}{x_{++}}$$

m_{GT} = *estimate of expected frequency*

x_{G+} = *sum of observed frequencies in the Gth or given row*

x_{+T}= *sum of observed frequencies in the Tth or target column*

$$z_{GT} = \frac{x_{GT} - m_{GT}}{\sqrt{m_{GT}(1 - p_{G+})(1 - p_{+T})}}$$

$p_{G+} = x_{G+} \div x_{++}$

$p_{+T} = x_{+T} \div x_{++}$

Figure 1 Formula used to calculate expected frequencies ([30]) (left) and formula used to calculate Z scores (right, inset)

5 RESULTS

Children actively engaged in the discussion and there were many responses. For each given code the observed target codes resulting from this are shown in Table 1 below. Each column represents the number of times that target code was observed to follow the given code shown in each row. The numbers in brackets show the expected frequencies calculated [30] for comparison. For example, following a given code of *Answer* there were 56 *Extending* target codes observed immediately afterwards but only 39 expected.

Table 1 Observed Frequency transitions vs. expected response frequencies (shown in brackets)

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	QUC
ANS	**0** (1)	**56** (39)	**35** (27)	**7** (5)	**4** (4)	**3** (7)	**0** (2)	**9** (13)	**18** (12)	**8** (27)	**1** (3)
ALA	**0** (1)	**25** (18)	**13** (13)	**3** (3)	**2** (2)	**4** (3)	**2** (1)	**6** (6)	**5** (6)	**7** (13)	**0** (1)
EXT	**0** (0)	**6** (12)	**17** (18)	**2** (2)	**1** (1)	**2** (2)	**2** (0)	**5** (4)	**2** (4)	**4** (8)	**1** (1)
QUE	**1** (0)	**2** (4)	**1** (3)	**0** (1)	**4** (0)	**1** (1)	**0** (0)	**3** (1)	**0** (1)	**3** (3)	**0** (0)
REQ	**0** (0)	**4** (4)	**4** (3)	**0** (1)	**1** (0)	**0** (1)	**0** (0)	**0** (1)	**0** (1)	**2** (3)	**4** (0)
INS	**0** (0)	**2** (4)	**3** (3)	**1** (1)	**0** (0)	**2** (1)	**0** (0)	**1** (1)	**2** (1)	**3** (3)	**0** (0)
SUM	**0** (0)	**0** (1)	**1** (1)	**0** (0)	**0** (0)	**1** (0)	**0** (0)	**1** (0)	**0** (0)	**0** (1)	**0** (0)
DIS	**0** (0)	**1** (10)	**0** (7)	**0** (1)	**0** (1)	**2** (2)	**0** (0)	**0** (3)	**0** (3)	**33** (7)	**0** (1)
AGR	**0** (0)	**10** (8)	**1** (6)	**0** (1)	**0** (1)	**0** (1)	**0** (0)	**1** (3)	**2** (3)	**14** (6)	**1** (1)
EVA	**0** (0)	**8** (14)	**7** (10)	**3** (2)	**0** (2)	**5** (2)	**1** (1)	**11** (5)	**8** (4)	**6** (10)	**1** (1)
QUC	**3** (0)	**2** (2)	**0** (2)	**0** (0)	**1** (0)	**1** (0)	**0** (0)	**1** (1)	**0** (1)	**1** (2)	**0** (0)

Table 2 shows the Z scores calculated with significant values highlighted in red. From these data a deduced behavior transfer diagram was produced and is shown in Fig. 3 below. This illustrates diagrammatically the weightings of target codes which follow given codes.

As can be seen from the Table 2 and Fig. 3, there is a strong link between reactions of *Questioning*, *Requesting* and *Question Complement*, which then leads to *Answer*, demonstrating a clear path through which children evaluate the questions that others ask by asking for further information. An *Answer* then leads to three significant reactions: *Alternative Answer*, *Extending* and *Agreement*, with the largest weight being *Alternative Answer* with a weighting of 4.0. *Alternative Answer*, however, only leads to itself. This shows that children were not always satisfied to accept a given answer demonstrating the presence of cognitive conflict.

The occurrence of *Agreement* following Answer has a weight of 2.0. This shows evidence of pupils presenting their position to support other pupils' ideas, as would occur in no conflict situations. In conflict situations responses of *Alternative Answer* and *Extending* were observed, although *Extending* also occurred in no conflict situations. No significance was found between *Answer* and *Disagreement* and these both lead to *Evaluation*. These results are similar to Jeong's ([1]) research.

Extending leads to itself but also leads to Summary. It seems that *Extending* reactions encountered by the children help to induce reactions of *Summary* showing that this further information aids the formation or reinforcement of knowledge. Reactions of Disagreement, Agreement and Evaluation show that children are able to present their own standpoints to others, whether different or the same and consequently information is assimilated ([15]), strengthening their knowledge. *Inspiration* has no significant lead to other responses but it does have two significant connections from *Evaluation* and *Summary*, as would be expected. The deduced behavior transfer diagram shown in Fig. 3 has been represented as the 5 phases proposed by Gunawardena et al. ([29]), shown in Fig. 4. This is discussed in more detail in the next section.

*Table 2 Z- scores for tests of significance (*Z-value > +1.65 represents statistically significant degree of continuity (p < .1)*)*

	ANS	ALA	EXT	QUE	REQ	INS	SUM	DIS	AGR	EVA	QUC
ANS	-1.4	**4.0**	**2.0**	0.9	-0.2	-1.9	-1.6	-1.3	**2.0**	-7.1	-1.3
ALA	-0.9	**1.9**	0.0	0.3	-0.1	0.4	1.5	0.0	-0.4	-4.6	-1.2
EXT	-0.7	-2.0	**3.6**	0.3	-0.3	-0.1	**2.3**	0.7	-1.0	-5.1	0.2
QUE	**2.3**	-1.3	-1.3	-0.8	**5.4**	0.3	-0.4	1.5	-1.2	0.4	-0.5
REQ	-0.4	-0.1	0.7	-0.8	0.8	-0.9	-0.4	-1.2	-1.2	-3.1	**7.2**
INS	-0.4	-1.1	0.2	0.7	-0.7	1.6	-0.4	-0.3	0.7	1.1	-0.5
SUM	-0.2	-1.1	0.6	-0.3	-0.3	**2.3**	-0.2	1.5	-0.5	-10.0	-0.2
DIS	-0.6	-3.5	-3.1	-1.2	-1.1	0.2	-0.7	-2.0	-1.9	**37.7**	-0.9
AGR	-0.5	0.9	-2.3	-1.1	-1.0	-1.3	-0.6	-1.1	-0.4	**15.1**	0.6
EVA	-0.7	-1.9	-1.0	0.9	-1.3	**1.7**	0.6	**3.4**	**1.9**	-3.8	0.1
QUC	**10.1**	-0.4	-1.5	-0.6	1.4	0.9	-0.3	0.2	-0.9	-4.2	-0.4

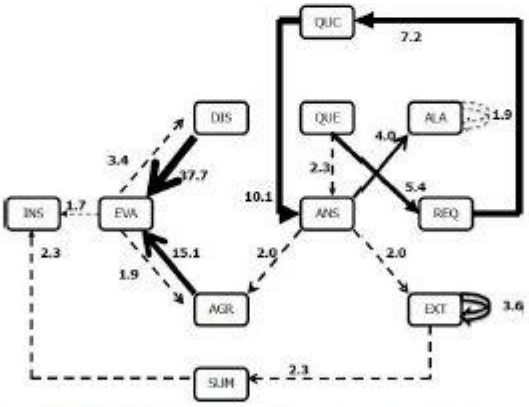


Figure 3 Deduced behaviour transfer diagram for Chinese pupils

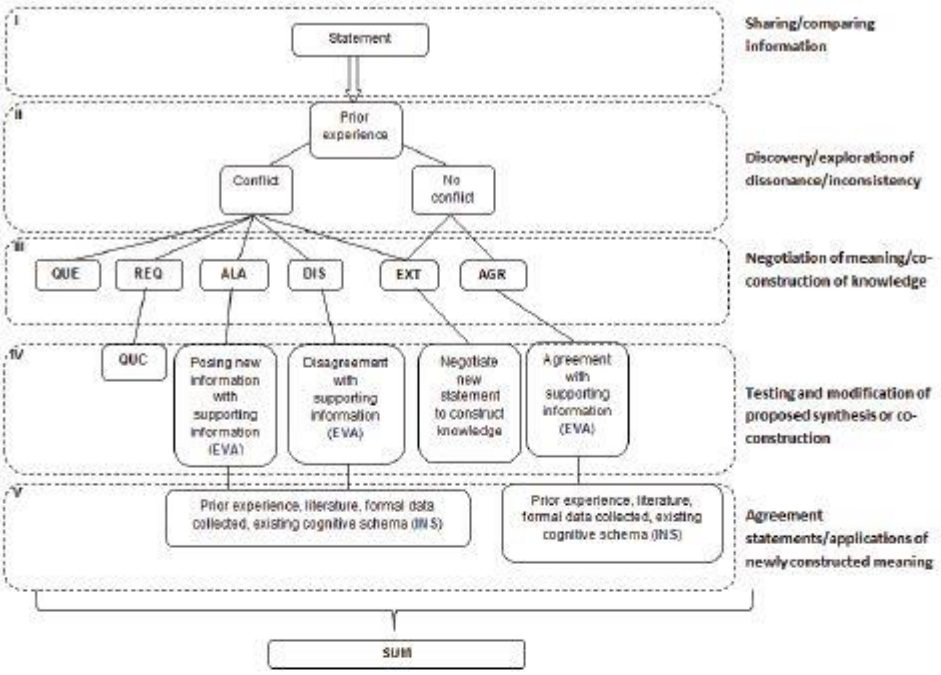


Figure 4 Model representing response patterns in the Chinese classroom
(Phases corresponding to Gunawardena et al. ([29]) model are shown on right)

6 DISCUSSION OF RESULTS

Analysis of the data collected shows that the pattern of interaction relates to the existing models ([20], [29]), which involve problem solving and critical thinking skills. Although this study is not focused on how to improve their problem solving and critical thinking skills, interaction between peers was inevitably involved in the problem solving process and argumentation. The problem solving processes involves seeking connections among contradictory pieces of information and evaluating new statements in the context of other evidence and hypotheses and these skills are necessary in order to recognize the complexity of a situation ([5], [22], [32]).

A model of response patterns has been produced from the data collected (Fig. 4). In the model two branches are shown, one representing cognitive conflict, and the other with no cognitive conflict. This model corresponds to that of Gunawardena et al. ([29]), the phases of which are shown on the right hand side of Fig. 4. Phase I of the observed behaviours involves actively joining the discussion to show one's own viewpoints. This is similar to the Critical Thinking Model although the latter is more focused on the first level of critical thinking by simply comparing others' statements and sharing one's own statement. Phase II of the observed behaviours emphasizes the classification of children's responses based on whether the children confronted conflict or not. The observed behaviours were classified as occurring in conflict or no conflict situations and these are also represented in Fig. 4.

Phase III of the observed behaviours emphasizes the different responses observed when confronted by either conflict or no conflict. These responses align with the Critical Thinking Model in that they were mechanisms used by the children to negotiate meaning and construct knowledge. This phase involves deeper knowledge building in the conflict situation and influences the mechanisms that are used in Phase IV to assimilate information (Phase V). It is this phase which illustrates why the children change their understanding or why they refuse to change their understanding. In contrast to Gunawardena's model Phase V emphasizes testing against existing cognitive schema, personal experience, formal data collected and contradictory testimony in the literature.

This model can be applied to illustrate the idea of cognitive conflict. As mentioned before, the existing literature explains the different levels of responses that people will perform when they are confronted

with conflict ([5], [20], [33]). However, they emphasise how people passively accept or not, the conflict information they confront. Our model representing response patterns in the Chinese classroom (See Fig. 4 as shown on the left), explains the different reactions that children will have in the process of dynamic interaction. The different reactions that children have and their behaviour in the second phase could be any reaction they experience in the responses present in the Piaget, Chinn and Brewer, and Chan's results ([15], [21], [22]). However they can still actively promote knowledge building. For example, if children experience ignore, reject and exclude reactions in the responses that Chin and Brewer proposed ([21]), they still post their own ideas through different reactions of requesting, questioning and disagreement. This helped the children to present their ideas and get feedback from others even when they rejected and excluded this idea. In contrast to the models proposed by ([38], [22]), this model focuses on how children can actively and iteratively review their own, and others', ideas. This interactive behaviour proves that knowledge is not static and closed where there is always a true and correct answer.

The different reactions that children demonstrate especially with their behaviour in the cognitive conflict, results in the promotion of dynamic exchanges and changes occur whereby new discoveries and new explanations of knowledge emerge ([34]). It is the first step to deeper learning when children start to compare their own ideas with others. Then gradually children will become involved in the process of knowledge building through argumentation and evaluation reactions. Although children cannot start to change their own ideas or to solve their conflict, information by interacting with others change can emerge and it is a good opportunity for them to review their own and others' ideas and can promote deeper thinking ([34]). Limon ([34]) pointed out that giving children conflicting information does not mean that children can change their understanding in their schema automatically. Conflict information can induce confusion and confliction in children, and it cannot simply make children statically receive the conflict or memorise specific information. The key core of the strategy of learning is to allow children to undertake a more active role and, as a participant, to negotiate and evaluate the knowledge they understand and challenge.

The Critical Thinking model was specifically designed to focus on online debate and critical thinking procedures in older individuals. The main purpose of this research is focused on how to design a learning environment to improve children's interaction. Although it also involved problem solving and critical thinking when evaluating children's behavior, language of children's debate has been proven to be totally different to that of an adult (see, for example,[35]). Children are unable to construct specific verbal sentences in which to explain their argument.

In summary, the pattern of children's reactions has revealed the process of discussion that they can become involved with. The process matches existing literature that points to the reciprocal process of exploring each other's reasoning and viewpoints in order to construct a shared understanding of a task. This research highlights reciprocal interaction, which requires students to propose (answer, alternative answer, extending) and defend their own ideas (disagreement, evaluation). It also requires the children to ask their peers to clarify and justify any ideas they do not understand (questioning, requiring, question complement). This kind of reciprocal process helps children to become more involved in reasoned dialogue in which they are able to compare their own ideas with those of another person. It is not only purely upon agreement and cooperation, but may also include disagreement and conflict.

Whilst having discovered and highlighted various processes to help with children's cognitive processing in knowledge attainment, this research has also discovered limitations to do with the children's patterns of behaviour during the discussion. As the results demonstrate, answers lead to alternative answers, agreements and extending, but they did not lead to disagreement. In addition, alternative answer and extending did not lead to other reactions except themselves. There are three possible threads, based on what was observed, which would generate such results, and these are shown in Fig. 5.

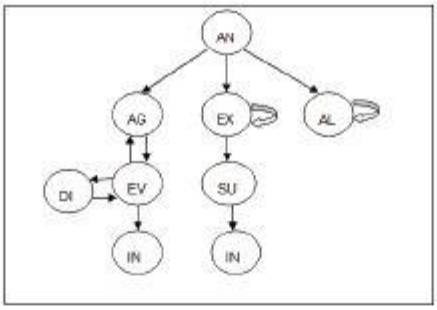


Figure 1 different possibilities of thread revealed from significant pattern of reactions

In Fig. 5 it can be seen that following and answer there were 3 possible reactions. If the reaction was *Agreement*, it would involve strong argument and evaluation of the idea, but without any new standpoint being proposed. If the reaction was *Extending* it leads to *Summary* and *Inspiration*. Alternatively, *Answer* followed by *Alternative Answer* will only lead to itself without involving any other reaction. However, a good pattern of discussion should be a reciprocal process to generate explanation, justification and reflection and the observed pattern of responses could be improved upon to generate deeper learning([2], [35]).

In a face-to-face learning environment, even when children are from the same class and have a similar background understanding of knowledge, there are often some pupils who have a greater understanding of the material than others. This is what was seen in the experiment and is one reason for the existence of *Extending* and *Alternative Answer* responses. This revealed the important role of more knowledgeable children in peer interaction and enables pupils to explore each other's reasoning and viewpoints in order to construct a shared understanding of the task. However, relationships between peers, even between more knowledgeable peers and less knowledgeable peers enables children to do this. But with a hierarchy such as parent-child or teacher-child, particularly in Confucian culture, this is much less likely to happen. In other words, children in a classroom are less likely to challenge information they receive if a teacher is present, and particularly so in a Chinese classroom. In this relationship, children would always respect the views of authority without a complete understanding of those ideas. Consequently, it would reduce the opportunity of reasoned dialogue because of that relationship and children would accept what they are told in a one-sided discussion. To promote engaged discussion between peers in a Confucian culture, and to therefore promote deeper learning, we propose augmenting the Chinese classroom and hence the model with technology. Fig. 6 shows our proposed new model illustrating in blue where technology could compensate for restrictions felt by children in their Confucian culture thus prompting more cognitive conflict and hence discussion and deeper learning. This future work is discussed in the next section and conclusions are drawn.

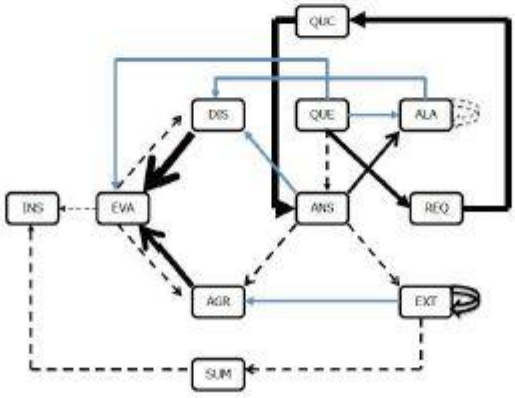


Figure 2 Proposed technological intervention to improve Chinese children's interaction patterns

7 CONCLUSIONS AND FUTURE WORK

This research involved observation of a set of classroom-based discussions in Chinese classrooms. A number of limitations exist in that each session lasted forty minutes and involved around 40 children at a time. In this face-to-face environment, with so many children present the discussion could not actively involve all children all the time due to the need to take turns. The limited time and need for turn taking resulted in fewer opportunities for all of the children to participate in the discussion and to develop their own ideas.

Another consideration is that whilst the teacher did not run or contribute to the sessions, they were present in the room. This may have had some dampening influence on the discussions.

The situation was also limited where the children were concerned because to retrieve any resources such as books or online information during the classroom based experiment would have been time consuming and was not possible due to limited time available. All of the answers given by pupils in the study were purely their own ideas and from their current understanding. They did not have many opportunities to review their answers from books or online resources.

We suggest that computer technology could help to overcome the limitations listed above not only to promote the sequences that were lacking but also to improve the depth of discussions. Further to this it would enable easier access to online resources to enhance information building and exchange. We have therefore proposed a model which shows how technology could enhance the sequences within discussions to enable deeper learning to take place. The next stage of this work is to investigate how this might be done and what such technology would look like.

REFERENCES

[1] Jeong, A. C. (2003). The sequential analysis of group interaction and critical thinking in online. *The American Journal of Distance Education,* 17(1), 25-43.

[2] Guiller, J., Durndell, A., & Ross, A. (2008). Peer Interaction and critical thinking: Face-to-face or online disucssion?. *Learning and instruction,* 18(2), 187-200.

[3] Woo, Y., & Reeves, T. C. (2008). Interaction in Asynchronous Web-Based Learning Environments. *Journal of Asynchronous Learning Networks,* 12, 179-194.

[4] Fosnot, C. T. & Perry, R. S. (1996). Constructivism: A Psychological Theory of Learning. *Constructivism: Theory, perspectives, and practice,* 8-33.

[5] Asterhan, C. S., & Schwarz, B.B. (2009). Argumentation and explanation in conceptual change: Indications from protocol analyses of peer-to-peer dialog. *Cognitive Science,* 33(3), 374-400.

[6] Chan, S. (1999). The Chinese learner – a question of style. *Education+Traning*, 41(6/7), 294-305.

[7] Biggs, J., & Watkins, D. (1996). The Chinese learner in retrospect. *The Chinese learner: Cultural, psychologcal and contextual influences*, 269-285.

[8] Salili, F.(2001). Teacher-student interaction: Attributional implications and effectiveness of teachers' evaluative feedback. *Teaching the Chinese learner: Psychological and pedagogical perspectives*, 77–98.

[9] Nield, K. (2004). Questioning the myth of the Chinese learner. *International Journal of Contemporary Hospitality Management*, 16(3), 189-196.

[10] Liu, I. M. (1986) Chinese cognition.

[11] Watkins, D. A., & Biggs, J. B. (2001). The paradox of the Chinese learner and beyond. *Teaching the Chinese learner: Psychological and pedagogical perspectives*, 3-23.

[12] Flowerdew, J., & Miller, L. (1995). On the notion of culture in L2 lectures. *TESOL quarterly*, 29(2), 345-373.

[13] Zhao, N., & McDougall, D. (2008). Cultural influences on Chinese students' asynchronous online learning in a Canadian university. *International Journal of E-Learning & Distance Education*, 22(2).

[14] Ku, H. Y., & Lohr, L. L. (2003). A case study of Chinese student's attitudes toward their first online learning experience.*Educational Technology Research and Development*, 51(3), 95-102.

[15] Piaget, J. (1959). The language and thought of the child (Vol. 5). Psychology Press.

[16] Vygotsky, L. S. (1980). Mind in society: The development of higher psychological processes. Harvard university press.

[17] Choi, I., Land, S. M., & Turgeon, A. J. (2005). Scaffolding peer-questioning strategies to facilitate metacognition during online small group discussion. *Instructional science*, 33(5-6), 483-511.

[18] Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999). How people learn: Brain, mind, experience, and school. National Academy Press.

[19] D'Mello, S., Lehman, B., Pekrun, R., & Graesser, A. (2014). Confusion can be beneficial for learning. *Learning and Instruction*, 29, 153-170.

[20] Limón, M. (2001). On the cognitive conflict as an instructional strategy for conceptual change: A critical appraisal. *Learning and instruction*, 11(4), 357-380.

[21] Chinn, C. A., & Brewer, W. F. (1993). The role of anomalous data in knowledge acquisition: A theoretical framework and implications for science instruction. *Review of educational research*, 63(1), 1-49.

[22] Chan, C., Burtis, J., & Bereiter, C. (1997). Knowledge building as a mediator of conflict in conceptual change. *Cognition and Instruction*, 15(1), 1-40.

[23] Kang, S., Scharmann, L. C., Noh, T., & Koh, H. (2005). The influence of students' cognitive and motivational variables in respect of cognitive conflict and conceptual change. *International Journal of Science Education*, 27(9), 1037-1058.

[24] Skoumios, M. (2008). SOCIOCOGNITIVE CONFLICT PROCESSES IN SCIENCE LEARNING: BENEFITS AND LIMITS. *Journal of Baltic Science Education*, 7(3).

[25] Chen, Y. C. (2011). Examining the integration of talk and writing for student knowledge construction through argumentation.

[26] Newman, D. R., Webb, B., & Cochrane, C. (1995). A content analysis method to measure critical thinking in face-to-face and computer supported group learning. *Interpersonal Computing and Technology*, 3(2), 56-77.

[27] Henri, F. (1992). Computer conferencing and content analysis (pp. 117-136). Springer Berlin Heidelberg.

[28] De Wever, B., Schellens, T., Valcke, M., & Van Keer, H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers & Education*, 46(1), 6-28.

[29] Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of educational computing research*, 17(4).

[30] Bakeman, R., & Gottman, J. M. (1997). Observing interaction: An introduction to sequential analysis. Cambridge university press.

[31] Hou, H. T., Chang, K. E., & Sung, Y. T. (2008). Analysis of Problem-Solving-Based Online Asynchronous Discussion Pattern. *Educational Technology & Society*, 11(1), 17-28.

[32] Schwarz, B. B., Butler, R., Nokes, T., Levine, J., Belenky, D., & Gadgil, S. Motivation and affect in peer argumentation and socio-cognitive conflict.

[33] Mason, L. (2001). Responses to anomalous data on controversial topics and theory change. *Learning and Instruction*, 11(6), 453-483.

[34] Limón, M., & Carretero, M. (1997). Conceptual change and anomalous data: A case study in the domain of natural sciences. European Journal of Psychology of Education, 12(2), 213-230.

[35] Knight, S., & Mercer, N. (2015). The role of exploratory talk in classroom search engine tasks. Technology, Pedagogy and Education, 24(3), 303-319.