NETWORK-BASED AUTONOMOUS AND COOPERATIVE LEARNING:

SELF-ORGANISED LEARNING ENVIRONMENTS IN A JUNIOR HIGH SCHOOL IN CHINA

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Abstract

Research in the field of Self Organised Learning Environments (SOLEs) has investigated a wide range of aspects of this approach to learning and teaching, including its application in vocational education and training, and the implications for educational strategies, metacognition, and child development. However, there has been relatively little research into how SOLEs can be used to improve learning outcomes within a traditional and exam-oriented teaching environment in China, and for a range of school subjects. This study seeks to address this gap by investigating how a SOLE can be integrated into the curricula for history and maths in a Chinese junior high school.

The study was conducted in Xining, a North-western Chinese city with limited educational resources and management systems. The study involved a class in the Eighth-grade with 58 students as the SOLE group, and another two classes which were taught by same history and maths teachers as a control group. Twenty history and twenty maths SOLE classes were conducted over nine months in two semesters. Data was gathered from students and students' guardians using questionnaires, and from students and teachers by means of semi-structured interviews, after-class diary forms, and homework assessments. Other data included classroom observation notes, and the results of three examinations.

Results suggest that most students enjoyed developing their knowledge of history in the SOLEs, and made progress in history scores. In addition, students enjoyed doing geometrical tasks much more than algebraic tasks in the SOLEs, but they were not able to improve their maths scores in the exams after using the SOLE in comparison with the non-SOLE classes. In order to make effective use of the Internet-based learning environments, participants in this SOLE study had to take on new roles, and the results suggest that both teachers and students adapted well to this requirement. There was also evidence that students can learn effectively with teacher support in a task-oriented interaction in a SOLE. The effectiveness of this approach varied between history and maths classes. This was partly linked to the existence of,

and the ability to locate, suitable online resources, though it may also have been linked to the greater dependence on scaffolding for particular subjects. These findings suggest the need for further research in larger scale studies over a broader range of school subjects, and in other educational contexts.

Dedication

This thesis is dedicated to the memory of my beloved grandfather, Zhanyuan Ma (1933-2014), a wise old man whom I still miss every day.

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Abbreviations

NCEE: National College Entrance Examination

P21: Partnership for 21st Century Skills

PBL: Project-based learning

SOLEs: Self-Organised Learning Environments

SOME: Self-organised Mediation Environment

VPNs: Virtual Private Networks

ZAD: Zone of actual development

ZPD: Zone of proximal development

Chapter 1. Introduction

1.1 Introduction

With the rise of the Internet, increased attention has been focussed on network-based learning and the role the student plays in using such a resource. A significant example of this is the 'School in the Cloud' (Mitra, 2013), a Self-Organised Learning Environment (SOLE) that involved teachers, parents, after-school programs and communities worldwide, with the intention of changing the way children learn.

Mitra (2015) provided a SOLE Toolkit to introduce how to bring the SOLE to the community. First, the educator should create a SOLE using computers with access to the internet, with students working in small groups (usually of four) round one computer, because peer learning and collaboration are essential aspects of the SOLE experience. Second, the educator spends about 5 minutes posing questions and explaining the SOLE process, students spend about 30-45 minutes working in groups to find answers to those questions online, and then students take about10-20 minutes to share what they have discovered. Mitra recommended that the educator should ask interesting and relevant questions which can stimulate learner's imaginations and curiosity.

The impact of Mitra's SOLE experiments has extended to twenty seven countries across five continents[1], but there is no research into how effectively a SOLE can be incorporated into curricula within an exam-oriented system such as that found in countries like China, and there is little research into the new roles which participants play when a SOLE is introduced into a school curriculum. Thus, this study is intended to fill these gaps, and aims to investigate the effectiveness of a SOLE within a school curriculum (history and maths) in China, the learning and teaching processes within a SOLE, and participants' attitudes towards a SOLE.

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[1] 'The future of learning: Self Organised Learning Environments (SOLES)', Newcastle University, REF 2014, http://impact.ref.ac.uk/casestudies2/refservice.svc/GetCaseStudyPDF/26757

1.2 Background of the SOLEs

In 1999, Mitra and his fellows sunk an Internet-connected computer in a wall in a slum in New Delhi, and anyone who passed by was allowed to use it freely. A video camera was placed near the kiosk for recording activity near the computer, and the researchers monitored the activity on the CPU from another computer on the network. There were no instructions given for its use, but Mitra found that children could click and explore it by themselves (Mitra and Rana, 2001). Over the next few years, Hole-in-the-wall experiments were replicated in India, Cambodia, and some other regions with similar results (Dangwal et al., 2006; Mitra and Quiroga, 2012). The results confirmed that groups of children could learn to use Internet-connected computers without any planned instructional intervention and formal training, and they could teach themselves and each other, irrespective of who or where they were (Mitra and Rana, 2001; Mitra, 2003; Mitra et al., 2005). Based on the knowledge gained by these experiments, Mitra started experimenting with a new kind of learning model which he later named 'SOLEs'– the Self-Organised Learning Environments.

A SOLE represents an innovative and creative approach to learning in which students choose their own groups and solve problems by using an Internet-connected computer with minimal intervention from mediator (teacher, researcher, or other people who can support them while learning), in contrast to the widely-found teacher-led model of learning. Curiosity is the key to learning, and in the SOLEs, students can focus on exploring an area which arouses their curiosity, in the process, teach themselves and teach other group members with unexpected ease. The SOLE has the potential to help learners access up-to-date information, acquire skills and solve problems efficiently in collaboration with other learners. Learning in a SOLE is moving away from the traditional model of teaching and passive learning towards a greater focus on active learning, and it gives learners the responsibility of taking control of their learning, even from a young age. SOLE's impact has been transformative in terms of the range of educators in schools and other non-educational organisations who have been inspired by it.

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Teachers, education policymakers, and some private agencies have conducted SOLE experiments in India, South Africa, Italy, UK, Argentina, USA, Australia, and in various other countries (Brito, 2015). Their research results showed that children could solve problems by themselves using an Internet-connected computer, and they could pick up some skills in English pronunciation (Mitra et al., 2003), computing (Inamdar, 2004; Dangwal et al, 2005), maths (Mitra et al, 2010), and reading comprehension in English and Spanish (Mitra and Quiroga, 2012). These researchers also demonstrated that children could answer those questions that only children several years older would normally be expected to manage.

The above experiments were mainly concerned with providing access to education for children in places where good schools did not exist and good teachers did not want to go, and with exploring the capacity of children in remote areas to acquire some basic skills in English, maths, and molecular biology via computers (Mitra et al. 2005; Mitra and Arora, 2010; Mitra and Dangwal, 2010). However, questions remain about the use of SOLEs in the school context. For example, it is still not clear how or even whether we can combine traditional teaching curricula with SOLEs to improve children's learning outcomes, and the researcher still does not know whether SOLEs can support the demands of all school subjects.

Different subjects have different characteristics and contents. For example, maths is about numbers and arithmetic, it is a study of calculations and logical thinking, and maths problems generally have only one correct answer; students have to do many chemistry experiments and activities in the laboratory to develop their understanding of chemical knowledge; and historical problems can be described or explained or evaluated based on objective facts and subjective claims. Thus, the author intended to investigate whether SOLEs can be embedded in school curricula, whether some subjects appear to be more susceptible to the effective use of SOLEs than others, and how effectively SOLES can be used to help students learn by themselves in various subjects.

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SOLEs are built when educators encourage students to work as a team to answer questions using the Internet. A SOLE lesson could be considered as a cooperative/collaborative learning based on constructivist principles, and is facilitated by Internet resources. In this study, the researcher also reviewed the relevant information on theories of constructivism, and discussed the connection between constructivism and SOLEs. A detailed literature review on constructivism will be given in Chapter 2.

1.3 SOLE Study in China

The Education System in China is composed of pre-primary, primary, junior secondary, senior secondary, post-secondary, and tertiary education levels. Fu (2005) and Yang (2010) state that the real differences in access to a (post-secondary) college for students from under-developed areas and developed areas partly result from the gap in early childhood education, and the different quality of primary and secondary schools they attended. Regional discrimination in the distribution of education resources is a long-standing problem in the educational system in China, the result of which is that students in western regions have less access to higher education than those in the urban, coastal areas.

Chinese teachers, parents, and students insist that a university degree is the only way to succeed, and as a result, they think the best learning methods are those which can help children get the best exam results. High school and university entrance exam results play a major role in determining the type of education received in China (Hannum et al., 2011). This exam-oriented system and the unequal distribution of education resources in China are discussed in Chapter 2.

This SOLE study was conducted in a Chinese junior high school, in Xining city, the capital of Qinghai province. Xining belongs to an area with weak educational resources and an under-developed education management system of the kind referred to above. The reality is that at present it is hard to improve the quality of teachers in this area, and students do not

have opportunities to access more innovative learning methods. The question of whether the introduction of SOLEs can compensate for these lacks and benefit students from an under-developed region is worth investigating. It is hoped that both teachers and students in this school can benefit from this study, and that the results will also have wider application beyond this particular context.

In a Chinese junior high school, maths, Chinese language, English, chemistry, physics, biology, history, geography, and politics are all compulsory (Kirkpatrick and Zang, 2011:37). This SOLE study was conducted in nine months over two semesters, and twenty history classes and twenty maths classes in the SOLEs were observed. After considerable discussion with the headmasters and teachers in this school, a class in the Eighth-grade with 58 students (57 after Nov. 2014) was selected as the SOLE group for both history and maths. Another class with 61 students was selected as the control group for history, and the control group for maths was a class with 60 students in the same grade.

This study would like to address three main research questions: 1) How effective is a SOLE method within existing school curricula for different subjects? The effective will be measured by observing the group activities in the class, and analysing learners' homework feedback and the exam results for different subjects. (2) What is the effect of the roles participants play in a SOLE? (3) What are the attitudes of teachers, students and parents towards a SOLE? Moreover, the research techniques and the data gathered using them are summarised below.

[Students]: Diary forms; Semi-structured interviews; Homework; Three exam scores;

[Teachers]: Semi-structured interviews; Reflective diary forms;

[Parents]: Questionnaires

[Researcher]: Classroom observations reports; Field notes;

The significance of this study can be viewed regarding the theoretical contribution to the SOLEs as well as the practical contribution to teachers and students in the exam-oriented education system in China. It is essential to conduct this study because using technology to change the traditional educational model is a tendency of educational development. Chinese teachers and students should consider receiving a new learning method to stimulate students' interest to study, rather than 'teaching/learning for the exam'. Therefore it is anticipated that this study would help students to find a way to enhance learning effectiveness in using Internet resources.

This study will be a significant endeavour in employing the ethnographic research to observe the learners' learning process in the SOLEs and record participants' changes in their attitudes and roles within an extended time. This study will give the researcher in-depth understanding regarding the concept of 'framing' and 'constructivism' in the SOLEs, which may provide guidance and theoretical support for the future research.

For the researcher, this study may help her uncover essential areas in China's education system that many other researchers have not explored. Besides, this long-term study mainly contributes to the following three aspects: 1) triangulation in data collection and analyses; 2) data collection with multiple methods (e.g. questionnaires, interviews, observation, reflective diaries, exam scores, homework); 3) on-going reflection on the research questions.

1.4 Definition of Key Terms

[Effective learning]

According to Watkins et al. (2002:4), learning is an activity of construction, handled with others, and driven by learner's agency. Effective learning is all of these at their best, plus the monitoring and review of whether approaches and strategies are proving effective for the particular goals and context (details see Section 2.6).

[Attitudes]

The word attitude (from Latin aptus) is defined within the framework of social psychology as a subjective or mental preparation for action (de Souza Barros and Elia, 1998), and attitude means the individual's prevailing tendency to respond favorably or unfavorably to an object, such as person or group of people, institutions, events, activities, and ideas (Tsiakis, 2014). Attitudes can be positive (values) or negative (prejudice) (de Souza Barros and Elia, 1998; Tsiakis, 2014) (details see Section 2.2.4).

[Collaborative and Cooperative Learning]

The terms collaborative learning and cooperative learning are often used interchangeably when it comes to students learning together. Oxford (1997:443) appears to indicate that collaborative learning is related to social constructivist philosophy, which views learning as 'construction of knowledge within a social context and which therefore encourages acculturation of individuals into a learning community', and 'cooperative learning refers to a particular set of classroom techniques that foster learner interdependence as a route to cognitive and social development' (Oxford, 1997:444) (details see Section 2.3.4).

[Framing]

Bernstein (1990:36) defines framing as 'the principle that regulates the communicative practices of the social relations within the reproduction of discursive resources, that is, between transmitters and acquirers'. The concept of 'framing' will be considered as the theoretical framework for this SOLE study (details see Section 2.4).

[Constructivism]

Social constructivism is thought of as a learning theory with roots in cognitive constructivism (Piaget, 1977) and socio-cultural theory (Vygotsky, 1978). According to Vygotsky (1978), social constructivism emphasises that all cognitive functions including learning generally depend on interactions with others (e.g. teachers, peers, and parents), and he also stresses the

importance of the socio-cultural circumstances in which learning takes place and the influence of context on what is learned (Vygotsky, 1978; Huang 2002; Sjøberg, 2007) (details see Section 2.5.2).

1.5 Outline of the Thesis

Following the introduction in this chapter, Chapter 2 provides a review of the literature on Internet-assisted learning environments, a discussion of constructivist theories of learning, and a detailed description of those aspects of the Chinese education system which are relevant to the study. It concludes by identifying the research gaps the study is intended to fill. Chapter 3 explains the research methodology used in this study. It mainly introduces the research questions, research philosophy, sampling techniques, data collection and analysis procedures. Chapter 4 and Chapter 5 focus on analysing the data gathered on learning processes and learning outcomes of history lessons and math lessons in the SOLEs. Using the field observation notes, after-class diary feedback, homework assessment and exam results, the results for the two subjects are compared. Chapter 6 discusses the research questions and research gaps in light of the results of the data analysis. The final chapter discusses limitations of the study, as well as some theoretical and practical implications, and concludes by recommending directions for future research on the use of SOLEs.

Chapter 2. Literature Review

2.1 Introduction

This chapter begins with an introduction to the development of SOLE research. Section 2.2.1 discusses the studies about learner autonomy, self-access learning, and project-based learning. Section 2.2.2 introduces the Internet-assisted learning and teaching environment. Section 2.2.3 summarises the current trend of research on SOLEs, and the following Section 2.2.4 introduces the significance of a mediator in a SOLE. This SOLE study was carried out in China, so Section 2.3 provides relevant details of the Chinese education system, including its exam orientation (Section 2.3.1) and unequal distribution of educational resources (Section 2.3.2). Then, a brief introduction to the regional context of this SOLE study will be presented in Section 2.3.3. As SOLE tasks are designed to be carried out in groups, Section 2.3.4 will compare the concepts of cooperative learning and independent learning. Section 2.4 introduces Bernstein's concept of 'framing' which was considered as the theoretical framework for this SOLE study. Section 2.5 reviews the relevant information on constructivism theories, and three research gaps which this research is intended to fill will be set out in Section 2.6.

2.2 Development of SOLE Research

As claimed in Chapter 1, a SOLE represents an innovative and creative approach to learning in which students choose their own groups (they can change groups and move around freely) and explore problems by using an Internet-connected computer with minimal mediator (teacher, researcher, or other people who can support their learning) intervention. Thus, in the next sections, the researcher will provide a review of the literature on learner autonomy, self-access learning, project-based learning, and the use of computers to promote the above.

2.2.1 *Relevant Studies*

(1) Learner autonomy

Before discussing the literature on SOLE research studies, the concept of 'learner autonomy'

will be reviewed. In 1979 the Council of Europe published Henri Holec's report Autonomy and foreign language learning (cited here as Holec 1981), since then, the concept of learner autonomy has been central to the Council of Europe's thinking about language teaching and learning. It seems that Holec's report was a contribution to the Council of Europe's work in adult education, which stressed the importance of learner self-management. According to Holec (1981), learner autonomy arises when the learners are willing to take charge of their own learning by independent learning activities, and learner autonomy should involve the aspects of 'determining the objectives; defining the contents and progressions; selecting methods and techniques to be used; monitoring the procedure of acquisition; evaluating what has been acquired' (Holec,1981:3). Little (1996) argues that learner autonomy could establish a personal agenda for learning, and it may take at least some of the initiatives that shape the learning process, and could develop a capacity to evaluate the extent and success of one's learning. Following this explanation of learner autonomy, autonomous learners are generally motivated learners, and learner autonomy appears to sit comfortably with constructivist theories of learning, though Holec does not explore the relationship between them (Little, 2007).

Smith (2000) conducted a research on second language learning, and he describes the establishment and activities of a network of teacher-learners of Japanese in Japan. It appears to suggest that the development of 'teacher-learner autonomy' is likely to be important in its own right, as well as in relation to the development of learner autonomy with students (Smith, 2000). Dam (2003) argues that less attention has been paid to corresponding teaching paradigms for teachers when Holec (1981) identified the characteristics of learner autonomy, and Dam (2003) agrees with Little's point (1991) that the development of learner autonomy should take place in close cooperation between teacher and students, rather than learning without a teacher. It may be necessary to highlight the teacher's responsibility when trying to develop learner autonomy (Dam, 2003). Furthermore, in Dam's terms, it seems that the pivot of learner autonomy should be an evaluation, and one of the critical issues in the autonomy

classroom is the continuous evaluation of self and others (Dam, 1995:49). Learners are expected to gradually take over responsibility for their own learning cycle by planning, carrying out the plans, and evaluating the outcome (Dam, 1995).

Schwienhorst (2002) explores the concept of learner autonomy through three different perspectives: an individual-cognitive perspective by Kelly (1963), emphasising learner awareness and personal constructs; a social-interactive perspective by Vygotsky (1978), emphasising interaction and peer collaboration; and an experiential and experimental perspective by Bruner (1986), emphasising active participation of the learner in the learning process. These three views share a number of beliefs about learning, and learner autonomy should not be misinterpreted as either merely self-directed learning (Schwienhorst, 2002).

Chan (2003) conducted a large-scale survey on learner autonomy in language learning carried out with students and English teachers at the Hong Kong Polytechnic University in 1998. This survey focused on the teachers' perspectives on their roles and responsibilities regarding learner autonomy. The findings from this study suggest that 'learner autonomy in Hong Kong cannot be fully encouraged without the relevant and knowledgeable support from the teacher' (Chan, 2003:49), so it would need the partnership of the teacher and students to develop a flexible teaching culture to improve the practice of learner autonomy (Chan, 2003).

Little (2007) describes constructivist approaches to pedagogy, and the argument from constructivism may be summarised as follows: each of us constructs our own knowledge through the interaction between what we already know and the new information, ideas and experiences we encounter. The work conducted by Little (2007:14) appears to indicate that 'learner autonomy now seemed to be a matter of learners doing things not necessarily on their own but for themselves', and he suggests that language learner autonomy is not an optional extra, sometimes required by the way in which learning is organised, but belongs at the very centre of language teaching theory and practice (Little, 2007:27). Thus, Little (2007:26) holds

the view that 'learner autonomy is the product of an interactive process in which the teacher gradually enlarges the scope of her learners' autonomy by gradually allowing them more control of the process and content of their learning'.

Although the studies discussed above relate to language-learning, taking responsibility for planning, pacing, monitoring and evaluating the learning process is relevant to the development of learner autonomy in other subjects. Bernstein (1971) promoted the concept of 'framing' to describe the controls on communication between individuals in the pedagogic relationship such as teacher and students. In the educational context, framing is enacted partly through transmitting skills or subject knowledge, and creating social order (Bernstein 1990). Moreover, framing may refer to the relationship between the teacher and the student and the degree of autonomy each participant has in that relationship, such as what the learner has access to, when content is taught, and environmental factors in which the learning takes place. (Bernstein, 1996) (details see Section 2.4).

Little (1996) explores the nature and processes of learner autonomy, and he also appears to consider how information systems and information technologies could contribute to the development of autonomy. Technology would support the improvement of learner autonomy to some extent, and the use of technology could stimulate, mediate and extend the scope of the social and psychological interaction on which all learning depends (Little, 1996).

According to Rüschoff and Ritter (2001), learner autonomy should be a concept which goes much further than simply 'offering the possibility of self-study' which was defined by Holec. As far as the use of new technologies is concerned, learner autonomy may not indicate simple self-access tutorials or individualised learning, but that educational technology in the broadest sense would allow the learner to proactively engage in the process of learning and knowledge construction, thus enabling learners to gradually decide individually upon the materials and strategies of learning best suited to a given aim (Rüschoff and Ritter, 2001:228). Schwienhorst

(2002) mainly adopts a similar position, and he appears to indicate that in a context of self-access and self-regulation, information systems support learners' active participation in the collection and organisation of their learning resources and tools.

As introduced in Chapter 1, a SOLE represents an innovative and creative approach to learning in which students choose their own groups and solve problems by using an Internet-connected computer with minimal intervention from mediator (teacher, researcher, or other people who can support them while learning). The SOLE has the potential to help learners acquire skills and solve problems efficiently in collaboration with other learners, but a minority of learners do not possess the ability to construct knowledge in a SOLE, and they need support from their group members and the teacher. Thus, in this SOLE study, autonomy should not be interpreted as simply self-directed learning, and it should not be limited to learning without a teacher. The author tends to suggest that learner autonomy in a SOLE is an interactive process that the teacher gives learners the responsibility of taking control of their learning, learners help each other to construct knowledge using Internet resources, and get help from the teacher occasionally, so relatively weak framing.

(2) Project-based learning (PBL)

Another concept which is closely related to SOLE research is project-based learning (PBL), which is created to engage students in the research of authentic problems. Learners could seek solutions to nontrivial problems by asking and refining questions, debating ideas, making predictions, designing plans and experiments, gathering and explaining data, drawing conclusions, communicating their thoughts and findings to others, asking new questions, and creating artifacts (Blumenfeld et al., 1991:371). According to Blumenfeld (et al., 1991), PBL could improve learner interest because it may involve learners in solving problems, in working with others, and in building real solutions, and PBL may have the potential to increase deep understanding. Blumenfeld's work leads him to the conclusion that PBL may require considerable knowledge, effort, persistence, and self-regulation on the part students,

and the teacher would play a critical role in helping learners' thinking, and helping them construct new understanding (Blumenfeld et al., 1991).

Furthermore, Bauer (2006:1) appears to indicate that the PBL process emphasises 'experience and experimentation, research and deepening understanding, teamwork alongside independent work', and Markham (2011:38) holds the view that 'PBL integrates knowing and doing'. It is likely that learners could learn knowledge of the core curriculum, but also could apply what they know to solve authentic problems and produce results that matter (Markham, 2011). PBL may refocus education on learners, not the curriculum, and PBL could offer teachers the opportunity to teach, observe, and measure the growth of real word skills (Markham, 2011).

Incorporating PBL into technology, Blumenfeld et al. (1991:393) argue that technology may play a powerful role in improving learner and teacher motivation and interests to do projects, because PBL could contribute to variety, challenge, interaction with others, and generation of artefacts. Moreover, they appear to indicate that technology could aid the teachers in achieving goals of PBL by making information more physically and intellectually accessible, guiding and promoting the use of learning strategies, and aiding in the production of artefacts (Blumenfeld et al., 1991: 393). The author agrees with Markham's argument that PBL learners could 'take advantage of digital tools to produce high quality, collaborative products' (Markham, 2011:38).

2.2.2 *Internet-assisted Learning and Teaching Environment*

Many researchers tend to argue that the future of education may belong to computers, the Internet and multimedia technologies, and that cloud learning will possibly have a significant impact on the educational and learning environment. Ercan (2010) reviewed the current status and probable considerations to adopt the cloud technology in the educational environment, and he appears to argue that cloud computing may automatically reduce the cost of organisational expenses and provide more powerful functional capabilities, because learners

generally have the opportunity to quickly and economically access various application platforms and resources through the web pages on-demand (Ercan, 2010). However, the disadvantages of cloud computing could not be ignored, such as the problems and constraints with application offerings and security issues.

Wang et al. (2012: 149) define cloud learning as 'a shared pool of learning courses, digital assets and resources, which instructors and learners can access via computers, laptops, IP-TVs, mobiles and other portable devices', and it seems likely that the core idea of cloud learning is sharing of resources, providing access to a variety of education platforms by means of internet-connected PCs, laptops tablets, or smartphones. Research conducted by Wang et al. (2012) appears to put forward the concept of mobile cloud education based on an amalgamation of cloud-learning and mobile-learning. They built and tested an innovative intelligent mobile cloud education system using a mix of Android phone and iPad platforms, and overall, the initial testing of this system has been satisfactory (Wang et al., 2012). However, more testing is needed with all other commonly used mobile devices (such as iPhone, mini-laptop, desktop) and on a larger scale (both in terms of learners and learning content).

Leloglu et al. (2013) distinguish various deployment alternatives to cloud computing and explain their benefits against standard e-learning requirements. It might be suggested that cloud computing has an essential scope to make a breakthrough in the whole education system, and e-learning solutions cannot possibly reverse the cloud computing trends (Leloglu et al., 2013:2). Zhou et al. (2013) tend to argue that the application of cloud services in education would be a revolutionary and innovative breakthrough in terms of educational resources and the ways of teaching and learning. There is a general agreement that public educational resources should be powerful learning support tools, so the usability, accessibility and sharing capability of the public education resource should be improved (Zhou et al., 2013). It seems likely that education informatisation paid more attention to the development

of web technologies in recent years. According to their research, 'cloud services have features of resource integration, standardisation, and personalities. These features are ideal for the sharing of resources in the field of public education and enable cloud computing to be an effective way to solve the existing education resource problems' (Zhou et al., 2013: 49). Although this conclusion is simply based on the current issues occurred in the process of development of China public education informatisation and may need further studies on a larger scale, the author would argue a similar view here.

Vockley (2007) describes the pivotal role of technology in a 21st-century education system, and he claims that 'In a 21st-century education system, technology must be used comprehensively and purposefully to support students in mastering the full range of what they need to learn (2007:6)'. The Partnership for 21st Century Skills (P21) includes Learning and Innovation skills, Information/Media/Technology skills, and Life and Career skills (Vockley, 2007), so citizens should master some basic computer skills and accept the advantages and disadvantages of the Internet in order to perform effectively in the 21st century. Meanwhile, Vockley (2007:3) also tends to argue that 'this is important, but technology proficiency is simply the point of entry to the digital world—and it is only a small sliver of the far-reaching utility of technology as a powerful enabling tool for a full range of essential knowledge and skills'.

Taken together, some learners and researchers may already using cloud-based educational applications and services, such as Google Apps Education, IBM Cloud Academy, HP Education Services, Salesforce, and GENICloud (Alshuwaier et al, 2012; Shirzad er al, 2012; Wang et al, 2012; Leloglu et al, 2013; Tredger et al, 2013; Zhaobin et al, 2013). However, it seems likely that the use of cloud-based services in education may be still at a nascent stage. Printed books may be in the process of being replaced by digitised books, and animations or video lectures may be possible to provide a better learning experience for learners (Vishwakarma and Narayanan, 2012). Cloud-based education services may bring more

convenience in sharing educational resources, and may lead to better learning outcomes (Pocatilu et al., 2009; Vishwkarma and Narayanan, 2012; Radhakrishnan et al., 2012; Alshuwaier et al., 2012; Fasihuddin et al., 2012).

As outlined in Chapter 1, SOLEs are created when organisers encourage students to work as a community to explore questions using the Internet, and students could access and share online resources to maximise the effectiveness of learning no matter whether they had received or lacked formal education. The SOLE could be seen as an innovative and creative approach which combines autonomous learning with cloud-based learning environments.

2.2.3 *Developments in SOLE research*

Section 1.2 described the 'Hole in the wall' experiment, which is the predecessor of SOLE research. The results of 'Hole in the wall experiments' and 'SOLE research' appear to indicate that groups of children could learn to use Internet-connected computers without any planned instructional intervention and formal training, and they could teach themselves and each other, irrespective of who or where they are (Mitra and Rana, 2001; Mitra, 2003; Mitra et al., 2005). Meanwhile, The SOLE Central web-site at Newcastle University (www.ncl.ac.uk/solecentral/) identifies a wide range of approaches to SOLE research, covering areas such as, educational strategies, child development, art and creativity, curriculum development, metacognition, reading and comprehension, and vocational education and training.

Mitra (2009) tends to argue that there are many places in the world, and especially in the developing world, where, because of restrictions due to geographical, economic, social, political, religious and other factors, well trained teachers would be unwilling to go (Mitra, 2009; Mitra and Dangwal, 2010). Thus, appropriate educational technologies, particularly those that enable children to learn more effectively without excellent teachers, should be introduced into schools in those places (Mitra et al., 2008; Mitra, 2009). A wide variety of studies have been carried out on SOLEs in some countries (Brito, 2015), and the researchers

were interested to observe if learners in a SOLE could improve their reading comprehension, behaviour, language, creativity or problem-solving abilities in different subjects, such as in computing, molecular biology, English, Spanish,and maths (Mitra, 2003; Inamdar, 2004; Dangwal et al, 2005; Mitra et al. 2005; Mitra et al, 2010; Mitra and Arora, 2010; Mitra and Dangwal, 2010).

For example, the initial 'hole-in-the-wall' experiment was conducted in Kalkaji, a suburb of New Delhi, India, 1999, and the researcher found that 'most of the slum children were able to use the computer to browse, play games, create documents, and paint pictures within a few days' (Mitra and Rana, 1999; Mitra, 2003). However, the Kalkaji experiment raised some doubts about whether the children had got inputs from computer literate adults in the vicinity, so Mitra and his fellows repeated the experiment in Shivpuri, no girls were observed to use the computer due to the area was unsafe and they found that boys could acquire the skills required to do the tasks described above (Mitra, 2003). In 2001, this experiment was repeated in a southeastern suburb of New Delhi, and over 500 children have been observed to use these kiosks regularly, and about 30 percent of the participants are girls. It seems likely that children could browse and search the Internet regularly. Younger children showed more interest in painting and games, and older children (12–13 years old) could read newspapers, browse cinema sites, and access educational material occasionally (Mitra, 2003).

In April 2002, five MIE kiosks (Minimally Invasive Education kiosks) were opened in Sindhudurg, India. The kiosks are placed in playgrounds or close to schools, and rural children between the ages of 8-14 are using these kiosks, many with no previous exposure to computers (Inamdar, 2004). 'Computers' is offered as an optional subject in some village schools at the eighth-grade level, but only a few are selected into the computer class at school, due to limited capacity. After two months, a local computer teacher reported a saving of 10% of his teaching time in the computers class because his students had been exploring at the kiosk, so the researchers selected three boys and three girls (13 years old) to take a test on a 2

hour 45 minute curricular examination in computer science, the exam was split between 'theory' and 'practicals', all six students passed the practical exam with very good scores, and only two students were close to passing the theory examination. After that, Inamdar and his fellows decided to examine larger numbers of children (37 boys and 66 girls, 12-13 years old) through an experimental study of MIE children's performance on two aspects of the eighth-grade 'Computers' exam. The findings from this experiment suggest that the method of learning while using MIE kiosks gave children enough knowledge and skills to pass the eighths grade curriculum examination for computer science, meeting an objective of primary education (Inamdar, 2004).

Ten years after the first Hole-in-the-wall experiment, in order to observe what and how much children could learn without subject teachers, Mitra and Dangwal (2010) explored the capacity of 10–14 years old Tamil-speaking children in Kalikuppam (a remote Indian village) to learn basic molecular biology in English on the Internet. Initially, children could access the downloaded material on molecular biology for 75 days without any supervision or instruction using their own Hole-in-the-Wall public computer facility, and later a mediator without knowledge of this subject could work with the sample group for a further 75 days (Mitra and Dangwal, 2010). A few months later, the researchers tested the children and found 'the children working in unsupervised groups around a Hole-in-the-wall computer were able to raise their test scores from 7% to about 30% in 75 days. A further period of 75 days with a mediator increased their scores to about 51%' (Mitra and Dangwal, 2010:683). These scores were comparable with those of children of the same age, taught by a trained and experienced teacher, in a privileged private school in New Delhi. Furthermore, Mitra and Dangwal (2010:685) appears to conclude that 'given unsupervised access to a computer with Internet-based instructional material the children were quite capable of organising themselves into self-learning groups and, without supervision and instruction, achieving the same levels as their peers in a nearby state government school but not those of similarly aged children in an affluent, urban school, so self-organised learning has its limits'. The evidence from this

study suggests that in unsupervised environments, different learners do what they like doing and therefore tend to excel in their particular areas of interest. Not each child learns something about everything. Some individuals may benefit, and others may not Mitra and Dangwal (2010).

In addition to the above, as described in Section 1.2, nowadays, teachers, education policymakers, and some private agencies have conducted SOLE experiments in India, South Africa, Italy, UK, Argentina, USA, Australia, and in various other countries (Brito, 2015). It seems likely that learning in a SOLE could help a majority of learners to improve their problem-solving abilities, and learners could expand their knowledge using the Internet. Learning in a SOLE would open up more opportunities for a majority of the learners from different areas.

According to the SOLE Toolkit (2015) provided by Mitra, in order to motivate learners' interests in deep and long conversations to solve problems, educators should pose 'big questions' in a SOLE. Big questions are often open and may be unanswerable, and learners cannot get an answer easily, to questions such as, 'Will robots be conscious one day?', 'Can anything be less than zero?', and 'How was music created?'. Mitra (2015) appears to indicate that big questions are a pivotal part of SOLE sessions. Asking an interesting and relevant question is the thing that stimulates children's imaginations and curiosity. The aim of big questions is to 'encourage deep and long conversations, rather than finding easy answers, and these questions encourage children to offer theories, work collaboratively, use reason and think critically' (Mitra,2015:16). A big question may connect more than one subject area, and it is not important what the right answers are, but the methods and skills to find the answers are important. Thus, those questions that cannot be answered by 'yes' and 'no', and require developed answers, thought and discussion, may be preferable for SOLEs.

In the school, different subjects have different characteristics and contents. Most maths problems in school generally have only one correct answer, but students may need to describe or explain or evaluate part of the history questions and politics questions based on objective facts and subjective claims, such as 'What were the major accomplishments of the Han Dynasty?', 'What are the advantages and disadvantages of representative democracy?', and 'How would you evaluate the contributions of liberalism to the study of globalisation?'. It seems likely that subjects with open-ended questions which allow learners to draw out their memories, opinions, and points of view may be more suitable for a SOLE. It could be claimed that school history is more interpretivist while mathematics is more objective. Thus, it would be helpful to observe if SOLEs could be embedded in school curricula, and whether some subjects appear to be more susceptible to the effective use of SOLEs than others.

It is noteworthy that a minority of researchers present contrasting opinions on the SOLE. For example, Paradowski (2014) appears to insist that autonomy needs assistance, and he also cited the experience of some researchers to support his view, such as Halves (2013), who claims that there is a 'clear perception that autonomy could only be achieved after a period of heteronomy, with children needing the pedagogic care of their Socratic teachers in order to achieve their full potential', and 'children may lack the cognitive skills necessary to render unaided peer-supported enquiry productive' (cf. Kuhn et al. 2000; Kuhn and Pease 2006; Dean and Kuhn 2007). Furthermore, Paradowski's (2014) argument against Mitra is that students are unlikely to get far if a teacher leaves them to follow their interests because knowledge requires competent scaffolding. Paradowski (2014:8) tends to argue that a teacher should 'select good content, pose the right questions, prioritise, structure and organise the process '.

According to Paradowski (2014:8), the role of the teacher should be that of 'a caregiver and counsellor, adapting instruction, prompting and encouraging, ensuring students stay on task, helping overcome obstacles, offering personal feedback and guidance, fostering good learning

habits, the ability to predict problems and find solutions, being an authority…'. Harmer (2014) also expresses similar opinions, so they tend to suggest that the intervention from a teacher is crucial and necessary in the classroom.

On the other hand, Paradowski (2014) tends to claim that education and the teacher should first focus on and benefit each individual learner, and should also praise individual achievement. The author agrees with Paradowski in respect of his point that 'while collaborative learning can bring benefits, children also need to learn how to learn on their own' (Paradowski, 2014:9), so in this study the author also encouraged students to use the Internet as a learning resource when they were at home.

Paradowski (2014:9) argues that groups often mean that 'one or two people do most of the work while others are freeloading', so group work is not always the most effective approach. However, in a SOLE, students are allowed to choose and change their own groups at any time (Mitra, 2015), and students could learn to manage relationships and develop their own solutions (Mitra, 2015). Thus, the author appears to argue that if the mediator could provide appropriate interventions when students complain that there is nothing to do because someone else is using the computer, learning with a group in a SOLE would be one of the effective ways for acquiring knowledge.

Paradowski (2014) also argues that knowledge acquisition should not be focused on the internet and collaboration, because 'this might lead to a terrible sense of insecurity' (Paradowski, 2014:9). As he had suspected, 'What if there is no WiFi? What if my battery goes flat? What when learners leave school and no longer have access to the internet?' (Paradowski, 2014:9). The author believes that learning in a SOLE could provide learners more opportunities to acquire knowledge, but the author does not insist that Internet resources and hand-held devices will eventually replace teachers.

In brief, Padarowski (2014) seems to have much less faith in the self-discipline of young learners, and to ascribe a greater role to the teacher in scaffolding learners – or at least keeping them focused on the task. In a SOLE, one premise for scaffolding as an effective way to support learning is Vygotsky's 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' (Vygotsky 1978: 86) (details see Section 2.5.2). The significance of the concept of the ZPD is that a certain amount of learning can take place by the learner working on his or her own, or by learners with peers at a similar level, but that in order to progress to the next level of development scaffolding is required – from a teacher or more knowledgeable peers. However, Padarowski (2014) seems to see an important role for the teacher even within the ZPD, and not just when moving from one ZPD to another. His argument (2014) seems to be that individuals within a group are unlikely contribute equally to the task, so there should be more individual work, and more intervention from the teacher. This seems to be an argument against the social-constructivist approach which forms the basis of Vygotsky's ideas and in the approach adopted, in the SOLEs, where ideally we wanted some scaffolding of the learning process from group members and Internet resources rather than from the teacher, although the teacher or other mediators were also encouraged to deliver interventions for those students who had limited access to the 'potential development' possible within the ZPD, and to help students develop greater independence in the learning process.

The author agrees with Paradowski (2014:10) in respect of his point that 'praise is good when deserved but it should be administered with care'. In this SOLE research, the history and maths teachers expressed appreciation for students' efforts when students share their stories of collective discovery, but the teachers did not overdone praise students if they realised something was wrong, they would encourage students to find out the similarities and differences between their answers.

Cuban (2013) also reviewed the research conducted by Mitra on the SOLE and the similar project designed by Nicholas Negroponte about One-Laptop-Per-Child initiative (OLPC), and Cuban (2013) tends to argue that it is too early to say what the benefits have been. Cuban (2013) recalls the rapid development of modern electronic products on educational innovations over the last 60 years, from instructional television to laptop programs, and he says nowadays laptops are slowly becoming obsolete since other devices (iPads, tablets, or smartphones) have nearly replaced them, so the magical thinking about dumping teachers and traditional schools disappearing may not be easy to achieve.

Cuban (2013) hold the view that although technology often does improve things, teachers and traditional education is hardly replaceable by high-tech schooling, and most people have unrealistic expectations on it. The author would argue a similar view to that of Cuban here. As in this SOLE research, most of the students insisted that a well-constructed and effective maths course could not be done without their teacher. As the rapid development of computer science and IT technology, exploring to use a multimedia computer to aid teaching has become a trend in current education reform. High-tech schooling may be useful in the appropriate situation, but we should not have excessive magical thinking about the technology.

2.2.4 *Mediators in a SOLE*

Mitra and his research fellows identify the role of a mediator within SOLEs as very important, and they conclude that a friendly but not knowledgeable mediator could improve the performance of those children (Mitra and Arora, 2010; Mitra and Dangwal, 2010). For example, Mitra tends to recommend participants to use computers with large screens in a SOLE, which could help a mediator observe what learners are doing, and when the students do their SOLE tasks, the mediator could stand back to encourage students to resolve any group issues themselves. Meanwhile, the mediator should observe learner's behaviour in the SOLEs and take notes to monitor change over time. Moreover, the mediator should ask

participants to review their SOLE experience and help them to do better next time (Mitra, 2015).

SOLEs also can be set up in remote or disadvantaged areas where access to education is limited, so some mediators can use Skype to join the SOLE. Mitra developed the term 'Skype grannies', who are mainly retired people, as volunteer e-mediators in the SOLEs (Clark and Hall, 2011; Mitra, 2015). They are not just to encourage learners' curiosity, but also to help in improving search skills that will allow children to begin answering hard questions more easily (Mitra, 2015).

In China, the teaching and learning procedures in a conventional class are predominantly teacher-centred and book-centred, i.e. students listen to the lectures and accept the knowledge offered by the teacher directly (Yue, 2016). Yue (2016) appears to argue that under the pressure of the exam-oriented education system, many teachers try to cram their pupils using 'duck-stuffing' type of teaching, and most of the teaching contents just repeat the textbooks, and students tend to lose their motivation to learn.

(1) Teachers' roles in the conventional education

Here are a few examples of teachers' roles summarised from students' and teachers' perspectives by many researchers in China. When a teacher conveys knowledge and assists students to learn, he/she is a provider (Wan et al., 2011); most teachers dedicate themselves to the teaching field, and they are enterprising in their career, so they are devotees who are always compared to a candle, chalk, and bee (Cui and Liu, 2009; Wan et al., 2011); the teacher also needs to help students set study goals and reach the targets, so the teacher is also an instructor and a prompter (Wan et al., 2011); in addition, teachers are regarded as a culture transmitter, authority, interest arouser, and co-worker in the teaching procedures (Wan et al., 2011). On the other hand, it seems that teachers outside of China are also compared to a candle, chalk, and bee (Guerrero and Villamil, 2002; Mc Grath, 2006; Saban et al., 2007).

Sometimes teachers have a responsibility to nourish students' potential abilities, and they are compared to a nurturer or gardener, who facilitates students' growth and development (Cortazzi and Jin, 1999). Panitz (1999:11) tends to conclude that in a teacher-centred situation, 'teachers are the bosses, leaders, and creators, while students are the employees, followers, and users.'

It is likely that learning in a SOLE is overturning the traditional teaching pattern, so the traditional role of the teacher may be changing with this situation. Thus, this SOLE study should consider what the roles a teacher play in a SOLE, and how the teachers adapt to their roles.

(2) Teachers' attitudes towards Internet technologies

The word attitude (from Latin aptus) is defined within the framework of social psychology as a subjective or mental preparation for action (de Souza Barros and Elia, 1998), and attitude means the individual's prevailing tendency to respond favorably or unfavorably to an object, such as person or group of people, institutions, events, activities, and ideas (Tsiakis, 2014). Attitudes can be positive (values) or negative (prejudice) (de Souza Barros and Elia, 1998; Tsiakis, 2014).

In the 21st Century, technology is all around us, and it is developing at astonishing speed into education. Teachers should envisage using technology to educate children because Internet technology has become an indispensable tool that will further engage students in learning (Liaw et al., 2007; Chow, 2015; Kisanga, 2016; Perry, 2018). However, the point of Fullan and Langworthy's article (2014) seems to be that technological revolution has not transformed most teaching and learning in classrooms, and where technology is used, research findings on its impact on learning outcomes are disappointing.

The author tends to agree with Chow's point (2015:5) that 'the introduction of new tools, concepts and solutions often do not work very well in their first iteration'. Change may encounter obstacles because many of the 'old guard' are distrustful of changing what they have been doing for their entire careers (Chow, 2015). Thus, the use of Internet technologies as teaching and learning tools may have its own technical hurdles. Gorder (2008) and Chow (2015) appear to argue that some teachers do not want to incorporate technology into their classroom because they are not very comfortable with it. Himsworth (2007) reported that only 20% of the teachers interviewed are comfortable using technology in the classroom, and Kisanga's findings (2016) indicate that 53% of the teachers had positive attitudes towards e-learning, whereas 47% had a negative attitude.

Liaw et al. (2007) appear to argue that individual attitudes constitute a significant factor to affect the usage of information technology, and Ferdousi (2009) also tends to argue that teachers' attitudes have a significant influence on their decisions about if, when, and how they will use technology. Liaw et al. (2007:1069) indicate that 'no matter how advanced or capable the technology is, its effective implementation depends on users having a positive attitude toward it'. It seems to be that teachers' perception and attitudes play a pivotal role of in the success or the failure for implementing innovative technology into education (Avidov-Ungar and Eshet-Alkakay, 2011; Teo 2011; Teo et al., 2011, Kisanga, 2016).

Teachers' positive attitudes and negative attitudes towards information and Internet technology could be attributed to different factors. The previous studies suggested that teachers' attitudes towards technology consist of three general classes of information: affective, cognitive, and behavioural evaluation (Triandis, 1971; Barki & Hartwick 1994; Liaw et al., 2007; Kisanga, 2016). The affective component is the experience of feeling or emotion which includes statements of likes or dislikes of an object (Liaw et al., 2007; Kisanga, 2016), the cognitive component refers to knowledge they have about the object and statements of beliefs (Liaw et al., 2007; Kisanga, 2016), and the behavioral evaluation is how

teachers have acted towards it in the past or intend to do (Eagly and Chaiken 2007; Fazio 2007; Liaw et al., 2007; Kisanga, 2016).

Early literature also associates teachers' attitudes by their personal characteristics such as age (Himsworth, 2007; Cavas et al., 2009), gender (Venkatesh et al., 2003; Hermans et al., 2008; Dong and Zhang, 2011), teaching experience (Cavas et al., 2009; Onasanya et al., 2010; Karaca et al., 2013; Chow, 2015), computer experience (Sahin and Thompson, 2006; Hermans et al., 2008; Cavas et al., 2009; Krishnakumar and Kumar, 2011; Karaca et al., 2013; Perry, 2018), and educational qualifications (Males, 2011; Rahimi and Yadollahi, 2011). Given the above, in this study, the researcher intends to know participants' attitudes and opinions towards integrating a SOLE in the classroom.

2.3 China's Education System

SOLE research has been conducted in many different countries, but there is no research into how effectively a SOLE can be incorporated into curricula within an exam-oriented system such as that found in China. In this section, an overview of features in the Chinese education system relevant to this study will be given.

2.3.1 *Exam-oriented Education System*

China's Ministry of Education manages China's current education system, and it is structured into early childhood education, 6-years of primary education, 3-years of junior high schools, 3-years of senior high schools (or secondary and tertiary vocational schools), and 4-years of colleges and universities (Hannum et al., 2011). In May of 1985, the government began a process of educational reform linked to economic reforms, and Nine-year compulsory education gradually becomes the key goal of China's elementary education program (Lewin and Hui1989; Hawkins, 2000). From Figure 2.1, the government funds the Nine-year compulsory schooling, which includes 6-years of primary education and 3-years of junior secondary education. By the age of 15, the majority of learners would progress to 3-years of

senior secondary schools, and some would choose vocational senior secondary education, where they would learn some vocational skills to enter the labour market directly. Access to higher education is based on the National College Entrance Examination (NCEE, or *Gaokao*) (Brandenburg and Zhu, 2007).

Figure 2.1: The structure of the Chinese education system

(Extracted from http://www.unicef.cn/en/atlas/education/869.html)

Qi (2004) points out that examinations play a pivotal role in student success in China. Students face numerous examinations as soon as they start their schooling. 'Only top-performing students in high-stakes tests may enrol in prestigious universities, get recruited for satisfactory jobs, and enjoy opportunities that are off-limits to lower scoring students' (Kirkpatrick and Zang, 2011:38). Following from Hannum's point, high school and university entrance exam results play an important role in determining the type of education received (Hannum et al., 2011). First, students who fail to attain the minimum passing score

cannot enter general or vocational high schools. In some provinces and cities, students face the risk of not graduating if their test scores are too low. Second, general or vocational high school graduates must take the *Gaokao* and meet the predetermined cut-off scores to enter university. Annually, the Ministry of Education determines three cut-off points for exam scores, one cut-off is for prestigious universities, the second cut-off is for medium-quality universities, and the third cut-off is the minimum passing score for entry into any University (Davey et al., 2007).

In China, school begins at 7:00 am with morning reading class followed by a 10-minute break every 45 minutes until noon. Afternoon classes begin at 14:30 pm and end at 18:00 pm. Except for the morning reading class, Chinese students have eight classes each school day. On average, students need to take 3 or 4 tests per subject each school year, and students accept a high volume of daily homework assignments (Kirkpatrick and Zang, 2011:37). Kirkpatrick and Zang (2011) describe a common phenomenon in their research that for most Chinese parents and students, the aim of education is nothing more than merely passing examinations. The *Gaokao* will measure college applicants' knowledge of three compulsory subjects—Mathematics, Chinese, English, and three additional categories—Physics, Chemistry, Biology (science and engineering students), or Politics, History, Geography (humanities & social sciences students).

2.3.2 *Unequal Distribution of Educational Resources*

Section 2.3.1 reviewed the Nine-year compulsory education policy in China, but in fact, primary schooling is still not universal in rural areas (Fu, 2013). Using the work of Robinson (2008), Hawkins et al. (2009) and Yang (2010), it points out that economic and educational development in the western regions is lagging behind that of the coastal and eastern provinces. Ying (2010:198) indicates that south-central China and north China outperform west China regarding the key indices of teaching quality assessment, such as the percentage of qualified primary school and junior secondary school teachers. Regional discrimination on education

resource distribution is a long-standing problem in the educational system in China (Wang and Chan, 2005; Davey et al., 2007; Robinson, 2008; Yang, 2010; Hannum et al., 2011). Education in western China is commonly of lower quality than that in more developed coastalareas of China, so students in western regions have less access to higher education than those in the urban, eastern provinces (Zhang and Zhao, 2014).

All Chinese high school students have the same goal, *Gaokao*. The high scores are also deciding factors behind getting a chance to attend elite universities (Kirkpatrick and Zang, 2011). As mentioned in Section 2.3.1, general or vocational high school graduates must take the *Gaokao* and meet the predetermined cut-off scores to enter a university, and different cut-off scores are required for different provinces. However, the different cut-off scores in *Gaokao* do not compensate sufficiently for unequally distributed education resources. The education department has encouraged the colleges to expand their enrolment, but increasing university enrolments does not mean reducing the entrance requirements to a low level. Yang (2010) claims that with the great expansion of the higher education system, the entry to the small number of high-quality universities is becoming very competitive, because with the limited quotas, elite universities will consider enrolling more students who received a better education from developed areas. One outcome of Li et al. (2013) also shows that poor, rural youth were almost 11 times less likely to enter the colleges than urban youth. Du (2007) indicates that the proportion of rural students in national elite universities has shown a downward trend in recent years. As Wang (2014) has shown, about two-thirds of the students who took the *Gaokao* were from the under-developed areas in 2010, but less than one in five of freshmen at Tsinghua University (top prestigious university in China) were from these regions. Meanwhile, the proportion of students from under-developed regions at Peking University (top prestigious university in China), has reduced from 30% to 10% in the past decade up to 2014, and 82% of students in medium quality universities were from under-developed areas in 2012.

Due to unequal institutional funding arrangements, unfair admission quota systems, poor academic and social preparedness, and uneven distribution of teachers in under-developed areas (Bowen et al., 2005; Fu, 2005; Yang, 2010; Hannum et al., 2011), learners are usually facing elimination out of junior high schools, or even primary level, thus missing the opportunity to take the *Gaokao*. Thus, learners from poor and rural backgrounds have unequal access to high-quality kindergartens, primary schools and junior high schools which can help them to prepare for the competitive entrance exams. It is a remarkable fact that students' opportunity of attending higher educational institutions highly associates with parental educational level (Yang, 2010; Hannum et al., 2011), in this way, educational inequalities can be transmitted from one generation to another.

Fu (2005) and Yang (2010) state that the real differences in access to a college from under-developed areas and developed areas partly result from the gap in early childhood education, and the different quality of primary and secondary schools they attended. Meanwhile, the low quality of the teachers in under-developed areas contributes to the unequal educational opportunities that directly lead to the disparity in enrolment in higher education (Fu, 2005; Yang, 2010). Thus, it is necessary to make primary and secondary education universal in socially and economically deprived areas.

2.3.3 *Regional Context of the SOLE Study*

Xining city, the capital of Qinghai province (Figure 2.2) is located in the northwest of China, and the largest city on the Tibetan Plateau. It has a total area of 7660 km2 and a population of 2,310,000 (Xining Government Website, 2015). Xining also belongs to an area with weak educational resources and an under-developed education management system. Its nominal GDP for 2012 was the second lowest in China. According to the sixth population census in 2010, Qinghai had the second-highest illiteracy rate (13.12%) in China (Statista, 2014), and there are only five universities in this province. In contrast, Beijing has around 90 standard institutions of higher education and 169 units for postgraduates training by the end of 2010.
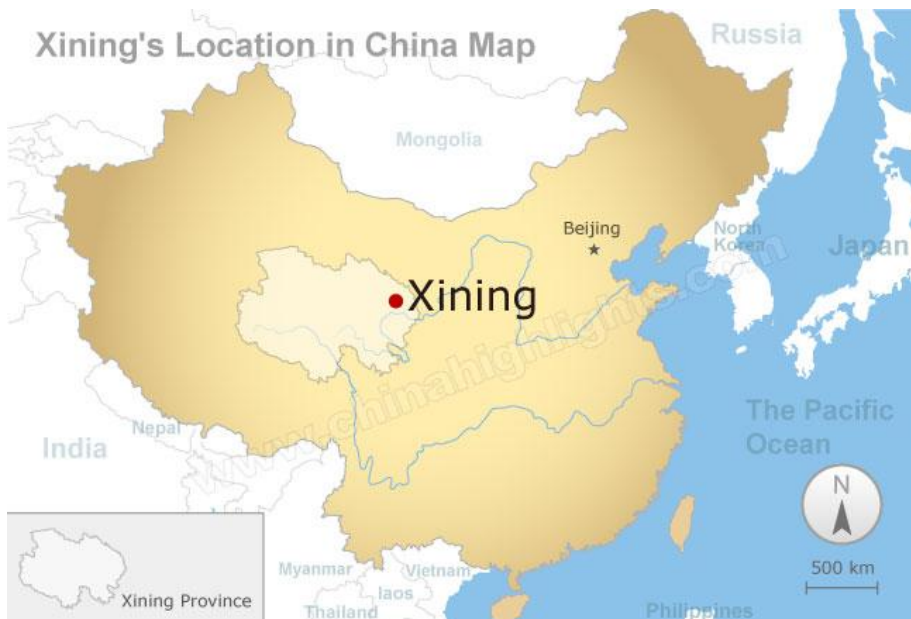
Figure 2.2: Location of Xining City in Qinghai, China

(Extracted from http://www.chinahighlights.com/xining/map.htm)

2.3.4 *Collaborative/Cooperative Learning or Independent Learning*

The terms collaborative learning and cooperative learning are often used interchangeably when it comes to students learning together. Collaborative learning is a method of teaching and learning in which students group together to explore a significant question or create a meaningful project[2]. Oxford (1997) tried to use a variety of sources to compare collaborative learning and cooperative learning, and he appears to indicate that collaborative learning is related to social constructivist philosophy, which views learning as 'construction of knowledge within a social context and which therefore encourages acculturation of individuals into a learning community' (Oxford, 1997:443). Panitz (1999:3) also holds a similar view that 'collaboration is a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning and respect the abilities and contributions of their peers'.

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[2] 'What are cooperative and collaborative learning?', https://www.thirteen.org/edonline/concept2class/coopcollab/index.html

In cooperative learning, students work together in small groups on a structured activity, and they are individually accountable for their work, and the work of the group as a whole is also assessed[3]. Oxford (1997: 443) appears to argue that 'cooperative learning refers to a particular set of classroom techniques that foster learner interdependence as a route to cognitive and social development'. Furthermore, Oxford (1997: 444) also indicates that 'cooperative learning has taken on the connotation of a set of highly structured, psychologically and sociologically based techniques that help students work together to reach learning goals'.

Panitz (1999:5) defines cooperative learning as 'a set of processes which help people interact together in order to accomplish a specific goal or develop an end product that is usually content specific', and he tends to argue that cooperative learning closely controlled by the teacher, and 'the fundamental approach is teacher centred, whereas collaborative learning is more student centred (Panitz, 1999:5). Rafael (2010) tried to compare the different features of the collaborative model and a cooperative model. In a collaborative model, the groups would assume almost total responsibility for answering the question, and the students determine if they had enough information to answer the question. The final product is determined by each group, after consultation with the teacher, and the students develop very strong ownership for the process (Rafael, 2010: 8).

According to Rafael (2010), in a cooperative model, the teacher asks the questions of a course and provides additional resources for the students to read and analyse, and offers assistance as needed. The groups show their results to the whole class and discuss their reasoning. The teacher would maintain control of the class, even though the students work in groups to achieve a goal (Rafael, 2010:7). In addition, it was also argued that in cooperative learning, activities are structured with each student assigned a specific role[4], students could learn skills

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[3] 'What are cooperative and collaborative learning?', https://www.thirteen.org/edonline/concept2class/coopcollab/index.html
[4] 'Collaborative learning vs. cooperative learning: what's the difference?' https://resourced.prometheanworld.com/collaborative-cooperative-learning/

for resolving conflicts when they arise and all contributions are valued, and research tools such as Internet access are made available[5].

Panitz (1999:4) tends to argue that 'the underlying premise of collaborative learning is based upon consensus building through cooperation by group members, in contrast to competition in which individuals best other group members', and Rafael (2010) also appears to argue that the basic premise for both collaborative and cooperative learning founded in constructivist theory. Taking the above-mentioned into consideration, it seems likely that some of the elements of cooperative learning may be used in collaborative situations, and cooperative learning could be regarded as a specific kind of collaborative learning.

According to the SOLE toolkit (Mitra, 2015), students need to form groups of about 4 with one computer to complete their SOLE tasks. Mitra et al. (2005) tend to argue that curiosity could drive children to explore their learning among groups, and children in groups may have capabilities higher than their individual capabilities. For example, Mitra and his fellows carried out a SOLE study in Montevideo, Uruguay, in June 2011, and due to limitations in time and finances, the experiments were planned over a three day period (Mitra and Quiroga, 2012). There were 78 children (average age 10) from the four schools participated in the study. The findings from this study show that children could read English and Spanish better in groups than individually, and children can perform better at 'hard' problems than they can individually (Mitra and Quiroga, 2012). The children told the researchers that in a group of four, when one child was unable to understand a word, others attempted to guess, so they liked working in groups with one computer because of 'four brains are better than one' (Mitra and Quiroga, 2012).

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[5] 'What are cooperative and collaborative learning?'
https://www.thirteen.org/edonline/concept2class/coopcollab/index.html

Learners in Mitra's SOLE experiments are required to work collaboratively. However, it seems likely that Chinese students prefer a teacher-centred class and expect teachers to be well prepared for lessons (Xiao, 2006).

Various academics have concluded that Chinese students tend to be passive learners who seldom ask questions in class and they depend more on teachers for information and reply more in the use of rote learning and memorising (Murphy, 1987; Ballad and Clanchy, 1991; Chan, 1999). Some academics believed that the style of Chinese learning might be very much influenced by Confucianism (Murphy, 1987; Chan, 1999; Bush and Qiang, 2000; Wong, 2004; Raymond and Choon (2017). Raymond and Choon (2017:198) summarised that 'Confucian ethic, strict discipline, proper behaviour and filial piety' could offer an explanation why students in class seldom asked questions. Students are therefore quiet and passive in class because they should not challenge the authority of teachers in the open, and they should respect their teachers and answer questions only when asked by teachers (Chan, 1999; Sit, 2013; Raymond and Choon, 2017).

In addition, Wong (2004) also appears to suggest that assessment systems would be a key factor which could help us to understand the learning styles of Asian students. The author has reviewed the exam-oriented education system in China (see Section 2.3), and it seems that this assessment system mainly provide opportunities (i.e. enrolling in prestigious universities or getting recruited for satisfactory jobs) to those who excel, rather than who desire it (Qi, 2004; Kirkpatrick and Zang, 2011). Huang and Prochner (2004) claim that parenting style is a principal factor that influences children's performance, and it directly relates to children's school achievement and goal setting. As Chen (2016) indicated, Chinese parents do put too many expectations and pressure on children, and children feel more pressure on their studies because their parents may feel shame if their children do not get better scores in schools (Wang, 2013). Thus, Chinese students must compete fiercely against their fellow students before winning a place at an ideal university, so some of them may be reluctant to share

learning materials and exchange learning experience with others.

According to Wong (2014), there is general agreement that Chinese students do not have much experience in group work, and learners found it difficult to work in a group especially with members that are not cooperative and unreliable. Chinese students are generally asked to answer questions in the class and complete their assignments independently, and there is seldom peer interaction or group discussion tasks in the process of learning before entering the university education. There is a preference to study individually so that they could have full control of the final result (Wong, 2014).

Cortazzi and Jin (1996) and Littlewood (2001) tend to suggest that in a collective-oriented culture, students may feel more comfortable when they engaged in discussion in small group rather than ask questions or express opinion openly in class, so in this SOLE study, the author would observe how effectively students will work in their new role in group learning.

2.4 Framing

Basil Bernstein's concept of 'framing' will be considered as the theoretical framework for this SOLE study, for understanding what happened when Internet technology was introduced into the educational context. Framing was first promoted by Bernstein (1971) to describe the controls on communication between individuals in the pedagogic relationship such as teacher and students. Bernstein (1990:36) defines framing as 'the principle that regulates the communicative practices of the social relations within the reproduction of discursive resources, that is, between transmitters and acquirers'.

According to Bernstein (1990, 1996), classification is related to power and is used to describe the relationships between categories, and it also refers to the boundary strength between what is classified. As Hoadley (2006:17) summarised, at a higher level of abstraction, classification refers to the social division of labour; at the macro level classification generates categories of

agents and discourses; and at the micro level, classification is about the organisational or structural aspects of pedagogic practice.

Bernstein (1990:36) indicates that 'control is always present, whatever the principles. What varies is the form the control takes. The form of control is here described in terms of framing'. According to Bernstein (1996:12), 'classification refers to *what*… and framing is about *who* controls *what*', and at the micro level of pedagogic practice, framing relates to who controls the communication, such as the form of the control of the communication between teacher and students, students and students (Walford, 1981; Hoadley, 2006; Badger, 2010; Erixon, 2010). Leat and Reid (2012:190) claims that '…young people have generally been positioned in a very subordinate role to adults with regard to the exercise of power and decision making in education', and in the educational context, framing refers to the strength of the social rules and is enacted partly through the instructional (transmitting skills and subject knowledge) and regulative discourses (creating social order) (Bernstein 1990; Leat and Reid, 2012).

Further, the communication could be governed by strong or weak framing. Where framing is strong (+F), the person making the transfer/transmitter explicitly controls the selection, sequencing/organisation, pacing, criteria, posture, and dress of the communicants (Interactional), together with the arrangement of the physical location (Locational) (Bernstein, 1990; Bernstein 1996; Hoadley, 2006; Badger, 2010; Erixon, 2010; Pausigere, 2016). Where framing is weak (-F), the recipients/acquirers may have a greater degree of control over the distinguishing features of the interactional and locational principles, and the control given by the transfer could be withdrawn at any time (Bernstein, 1990; Hoadley, 2006; Badger, 2010; Erixon, 2010; Pausigere, 2016). Thus, it is suggested that strong framing (+F) may control lies with the teachers, whereas weak framing (-F) control lies apparently with the student (Bernstein, 1996).

Bernstein (1975) appears to state these differences in terms of framing: 'we can consider the variations in the strengths of frames as these refer to the strength of the boundary between educational knowledge and everyday community knowledge of teacher and taught' (Bernstein, 1975: 206). Framing, therefore, opens up new potential for the change of boundaries (Hoadley, 2006).

Taking a power perspective, the teacher could decide the content and the forms of their teaching based on the textbook and the framing it offers through professional experience (Erixon, 2010), and it means that teacher may play a pivotal role in terms of selection and sequencing of knowledge (Ellery, 2017). However, when we integrate the technology into the content of teaching, the conventional textbooks lose their role in the teaching, students may be often more proficient in than their teachers, and teachers would be less able to prepare teaching content presented by the textbook (Erixon, 2010).

Following the point from Dolan et al. (2013:12), 'framing reflects power structures in education and strong framing has many associations with convergent pedagogy and assessment…, SOLEs have the potential, particularly when pupils have some responsibility for generating and refining questions, to reframe the relationship between learner and teacher, and learner and curriculum'.

Here is an example that could lead to a better understanding of framing in different cultural backgrounds. Li and Ginsburg (2006) conducted a study to examine the classification and framing of maths knowledge in Hong Kong, mainland China, Singapore, and the United States. In this study, two text levels were analysed in student versions, including 1) chapters within a book and 2) sections within a chapter. Furthermore, the content was examined with two content contrasts, including 1) between maths and non-maths content and 2) between algebra and non-algebra content. On the other hand, Li and Ginsburg (2006) also analysed the teacher's versions of these texts with attention being focused on guidelines. In this thesis, the

author would focus on reviewing the discussion from mainland China and the United States.

Li and Ginsburg (2006) indicate that mainland China has a centralised education system, whereas the United States has a decentralised education system. Curriculum guides and materials used in China's education systems are required to bear an approval from a national or system-level authority, and the majority of teachers and students system-wide have to cover the same content that is specified in syllabus and textbooks because the textbook is the base for classroom instruction (Li and Ginsburg, 2006). In contrast, 'the United States leaves such responsibilities of developing curriculum guides and selecting textbooks to states, local school districts, schools, or even individual teacher', and teachers usually do not need to follow any specific materials (Li and Ginsburg, 2006: 201). Thus, it seems likely that teachers and students in China have almost no flexibility in deciding what is taught and learned, but teachers (and perhaps students) in the United States have had.

Li and Ginsburg (2006) compared the maths textbooks from China and the United States. They found that teacher's version of texts in China provide instructional suggestions for teaching each chapter, generally including 1) instructional requirements, 2) textbook analysis and instructional suggestions, (3) answer keys or hints for the exercise problems, and 4) appendices with additional information related to the content contained in a given chapter in the student's version text (Li and Ginsburg, 2006: 202), and teachers are required to teach students the knowledge presented in their textbooks. In contrast, the U.S. texts tend to show clear and strong suggestions to teachers (and, through teachers, to students) to bring in knowledge from outside the curricular knowledge specified in the textbook (Li and Ginsburg, 2006). One thing should notice that the U.S. algebra texts indicate a higher degree of classification and framing than the U.S. non-algebra texts, because of the social class stratified curricular tracks in many schools in the United States (Li and Ginsburg, 2006). According to this example, it could be seen that China's maths textbooks exhibited a higher degree of classification and framing than either the US algebra or the US non-algebra books.

Li and Ginsburg (2006: 206) tend to emphasise that 'different strength patterns of knowledge framing are also consistent with authority relationships'. In the United States, teachers are encouraged to make use of a variety of curriculum materials and pedagogical approaches in their classrooms, and student cooperative learning in small groups is a popular approach in U.S. maths classrooms. In contrast, teachers in China have very limited autonomy in deciding what is taught, so the maths class in China is often didactic with the teacher assuming the role of lecturer. Generally, students are assumed only to follow the teacher's instruction and requirements in the class (Li and Ginsburg, 2006).

In conclusion, the author will use Basil Bernstein's concept of 'framing' as a theoretical framework for this SOLE study.

2.5 Constructivism

2.5.1 *Learning Theories Review*

As Ertmer and Newby (2013) concluded, learning has been defined in numerous ways by many different theorists, scholars, and educational practitioners. Although it is hard to reach a consensus on any single definition, many definitions display common elements. Siemens (2004:2) appears to indicate that 'learning theories are concerned with the actual process of learning, not with the value of what is being learned'. For instructional designers, different well-defined questions serve to distinguish each learning theory from the others, such as 1) the way learning occurs; 2) the way transfer occurs; 3) the factors that influence learning; 4) the role of memory; 5) learning approaches explained by the theory; 6) the basic principles which are relevant to instructional design; and 7) the way instruction can structured to facilitate learning (Schunk, 1991; Ertmer and Newby, 2013). It is suggested that Behaviourism, Cognitivism, and Constructivism are the three major theories which employed by teachers in the classroom. (Cooper, 1993; Mergel, 1998; Mishra, 2002; Fosnot, 2005; Siemens, 2005; Nagowah and Nagowah, 2009; Ertmer and Newby, 2013).

Watson, Pavlov, Thorndike and Skinner are four core scholars who developed Behaviourism. Watson was the founder of behaviourist theory, Pavlov was the first to introduce the concept of conditioning through studying digestion in dogs, Thorndike's research focused on instrumental learning and formalised the law of effect, and Skinner led to the development of operant conditioning within behaviourism (Mergel, 1998). Good and Brophy (1990) appears to indicate that Behaviourist theory focuses on the research of overt behaviour that can be observed and measured, and it places emphasis on stimulation from the external environment (Carmichael, 1927; Ertmer and Newby, 2013). Behaviourism is based on the view that learning is a connection between stimulus and response (S-R bond), and learning is a passive and long process that involves trial-and-error (Skinner, 1953; Fosnot, 2005). One central tenet of Behaviourism is everything you know, everything you are, is the result of repeated behaviour and experience (Schuman, 1996; Mergel, 1998). Behaviourism ignores the possible influence of thought processes, and the learner is characterised as being reactive to conditions in the environment as opposed to taking an active role in discovering the environment (Winn, 1990; Mergel, 1998; Ertmer and Newby, 2013).

As early as the 1920s researchers started to find limitations in the behaviourist approach to understanding learning (Mergel, 1998), and in the late 1950s, learning theory began to make a shift away from the use of behavioural models to an approach that relied on learning theories and models from the cognitive sciences (Ertmer and Newby, 2013:50). Cognitivism is based on the thought process behind the behaviour, and the changes in behaviour are used as indicators for observing what happens inside the learner's mind (Schuman, 1996). Psychologists and educators started to de-emphasise a concern with overt behaviour and emphasised instead more complex cognitive processes such as thinking, problem-solving, language, conceptualisation, and information processing (Snelbecker, 1983). Behavioural theories suggest that teachers ought to arrange environmental conditions so that learners respond properly to presented stimuli, and cognitivism also emphasises the role of environmental conditions in facilitating learning (Schnaitter, 1987; McLeod, 2003; Ertmer

and Newby, 2013), but Cognitive theories stress the need to create learning environments that encourage learners to organise and link new information to previously knowledge in memory (Bower and Hilgard, 1981; Ertmer and Newby, 2013). For example, a teacher can use cognitivism in the classroom to pose questions to guide learners refine their thinking and recognise where they may be wrong, or introduce some new concepts to encourage students to redefine something. Learners play an active role in exploring ways to process information that they received, and new knowledge and skills will be reflected through what is already known and stored within the memory. Thus, cognitivism underlines the active involvement of the learner in the learning process. It addresses the issues of how information is received, structured, organised, sequenced, stored, and retrieved by the mind. Learning is concerned with what learners understand and how they come to acquire it, and it is an internal and active mental process (Good and Brophy, 1990; Jonassen, 1991; McLeod, 2003; Ertmer and Newby, 2013).

Huang (2002:32) summarised the work on constructivism by Piaget (1970), Vygotsky (1978), and Glasersfeld (1989), he states that 'constructivists emphasise that teaching and learning should be learner-centred'. Ertmer and Newby (2013) also claimed that both learner and environmental factors are crucial to the constructivist, as it is the specific interaction between these two variables that construct knowledge. The philosophical assumptions underlying both the behaviourist and cognitivist theories are objectivistic, that is: the world is real, external to the learner. Constructivists admit the existence of the real world but contend that what we know of the world derives from our own interpretations of our experiences, and we all construct our own perspective of the world (Schuman, 1996; Ertmer and Newby, 2013).

The influential philosophical and epistemological assumptions of constructivism are: 1) learning is an active process, and knowledge is constructed from knowers' experiences and understanding; 2) learning is created in the mind via interaction with the world and is based on interpretation; 3) there is a real world that sets boundaries to what we can experience, but

reality is local and there are multiple realities; 4) testing should be combined with the task and not a separate activity; 5) knowledge growth comes from sharing of various perspectives and the changing of the internal representations through collaborative learning (Jonassen, 1991; Merrill, 1991; Cobb, 1994; Philips, 1995; Vrasidas, 2000).

As outlined above, different principles of these three learning theories can be used as guidelines to help the educator select instructional tools, techniques and strategies to promote learning. Considering the learning approach, instructional tools, learning environments, teaching principles, and the role of the participants in the SOLE study, the relationship between Constructivism and the SOLE context will be discussed in the following sections.

2.5.2 *Introduction to Constructivism*

In the educational field, there are several interpretations of constructivism, as indicated by the variety of qualifiers that are used, including:

1) Individual and cognitive constructivism (Piaget, 1977);

2) Social constructivism (Vygotsky, 1978);

3) Simple/Mild/Naïve constructivism (Piaget, 1977);

4) Radical constructivism (Glasersfeld, 1989).

In this thesis, the researcher will review two interpretations which are widely accepted and used: Cognitive constructivism and Social constructivism.

Piaget (1977) put the focus of constructivism on how individuals construct knowledge and form meaning based upon the experiences. He points out that knowledge and the world are both constructed and constantly reconstructed through personal experience (Ackermann, 2001). Piaget's stage theory explains the cognitive development of children, and it proposes four distinct stages (Eggen and Kauchak, 2000; Ojose, 2008; Powell and Kalina 2009):

1) Sensorimotor (age 0-2): infants perceive the world through sensory experiences and objects, and they cannot acquire knowledge from others' viewpoints.

2) Preoperational (age 2-7): children begin to think symbolically, but they still have trouble taking the viewpoint of others.

3) Concrete operational (age 7-11): this is a turning point, children are no longer egocentric, and they can conserve and think logically but still very concretely.

4) Formal operational (age 11-adulthood): people can think logically or abstractly about the world around them, and can find multiple potential solutions to problems by metacognition.

Piaget believed that all people develop steadily and will pass through each stage before entering the next one, no one skips any stage.

Piaget described cognitive development as a process of adaptation to the world, and this happens through: 1) assimilation (fit new information into existing schemas/perceptions); 2) accommodation (revise existing schema/understanding so that new information can be incorporated), and 3) equilibration (maintain a balance between assimilation and accommodation) (Wadsworth, 1996; Powell and Kalina 2009:242).

In cognitive constructivism, knowledge is constructed in individuals as a personal process (Piaget, 1977), as opposed to social constructivism, in which knowledge is constructed by interaction with the teacher and other students (Vygotsky, 1978).

Vygotsky's socio-cultural theory originates from the study of child psychology, and it tends to emphasise the fundamental role of social interaction in the development of cognition (Vygotsky, 1978). Mediation is a core concept of socio-cultural theory, and for Vygotsky, mediation represents the use of tools, which are adopted to figure out a problem or achieve a goal (Kao, 2010). Kao (2010, cited in William and Burden 1999) also appears to argue that mediators can also be people who enhance a child's learning.

An important concept in socio-cultural theory is known as the zone of proximal development (ZPD). Vygotsky (1978:86) defines ZPD as:

> '…the distance between the actual development 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'.

In essence, this zone includes all of the knowledge and skills that a learner cannot yet understand and use but is capable of learning with guidance and social interaction. The knowledge and skills that a learner could master or could independently perform on their own without assistance are in the zone of achieved development (ZAD) (Denhere et al., 2013).

An experienced mediator may provide the learners with 'scaffolding' to support their evolving understanding of knowledge domains or development of complex skills. Wood, Bruner and Ross (1976) were the first to use the term scaffolding as a metaphor in the learning context. Scaffolding was used to describe the nature of parental tutoring in the language development of young children at first (Searle, 1984; Hammond and Gibbons, 2005). Scholars point that successful parents-scaffolders focused their children's attention on the learning task and kept children motivated and working on the task. Bruner (1978: 19) describes scaffolding as:

> '…the steps taken to reduce the degrees of freedom taken in carrying out some task so that the child can concentrate on the difficult skill she is in the process of acquiring'.

In the circumstances of classroom interaction, scaffolding refers to all kinds of instructional methods used to move students gradually toward better understanding and, ultimately, greater independence in the learning process. The term scaffolding describes the temporary but essential nature of the mediator's assistance in supporting students to carry out tasks or

develop new knowledge, and they will later be able to complete similar tasks alone (Maybin et al. 1992; Hammond and Gibbons; 2005).

Social constructivism is thought of as a learning theory with roots in cognitive constructivism (Piaget, 1977) and socio-cultural theory (Vygotsky, 1978). A majority of learners could benefit from it since social interaction and collaboration learning are combined, and they could construct knowledge actively (McDonald and Gibson, 1998; Huang 2003).

According to Vygotsky (1978), social constructivism emphasises that all cognitive functions including learning generally depend on interactions with others (e.g. teachers, peers, and parents), and he also stresses the importance of the socio-cultural circumstances in which learning takes place and the influence of context on what is learned (Vygotsky, 1978; Huang 2002; Sjøberg, 2007). Vygotsky tends to argue that the cultural circumstances give learners the cognitive tools needed for development, and parents and teachers are conduits for the tools of the culture (Vygotsky, 1978; Turuk, 2008). Turuk claims that 'Vygotsky advocates that humans do not act directly on the physical world without the intermediary of tools' (Turuk, 2008:2), and the human mind is mediated.

Social constructivism rejects the view that individual cognition is the sole generating force in knowledge construction, and supports the view that knowledge is a cultural or negotiated artefact created in cooperation and understanding with others (Hyslop-Margison and Strobel, 2007). Petraglia (1998) and Huang (2002) summarise the early work of constructivists such as Dewey (1916), Vygotsky (1978) and Bruner (1996), concluding that all of them believe that learners do not learn in isolation from others, that interactivity provides a way to motivate and stimulate them, and that knowledge is constructed based on learners' experiences and social interaction with others.

Given the above, for cognitive constructivists, knowledge is constructed in the head of the learners while people are organising their experiences and cognitive structures (Piaget, 1977; Glasersfeld, 1989). For the social constructivists, knowledge is constructed through collaboration and social interaction with others (Vygotsky, 1978; Brown et al., 1989; Lave and Wenger, 1991). These two constructivist theories are seen as more or less opposites, but there are some fundamental similarities between them. The two theories focus on the learner's control of his or her learning processes, and both insist that knowledge does not exist independently of the learners, and that learners could learn actively and construct new knowledge based on their previous experience. The constructivist sense of active learning is not listening and then reflecting the view of reality, but rather engaging in and interacting with the surrounding environment to produce a personal understanding of the world. Constructivists believe that knowledge constructed by learners is not inert, but rather usable in new and different situations (Jonassen et al., 1995; Vrasidas, 2000; Rahimi and Ebrahimi 2011).

Under constructivism, nothing is learnt from scratch. Learning is not knowledge-transmitting from teachers to students, but knowledge-constructing by students themselves. Students are not the passive receivers of knowledge, and they can construct and expand knowledge based on their existing experiences, or through the collaboration and social interaction with others. At this point, the view from different tendencies of constructivism is basically unanimous.

2.5.3 *Constructivism in the classroom*

As introduced in Section 2.2, a SOLE is an approach to learning in which students choose their own groups and solve problems by using an Internet-connected computer with minimal mediator intervention, and it is in contrast to the traditional prescriptive learning model.

The Internet as a learning tool is a core factor in the SOLEs. In previous studies, authorities have argued that online learning environments have become a common tool for

learner-centred or constructivist learning, and the interactive nature of the Web permits students to explore a variety of resources and build connections with other knowledge domains that are meaningful to them (Dede, 1996; Jonassen et al. 1995; Oliver, 1999; Vrasidas, 2000; Huang, 2002; Mishra 2002). In the SOLEs, knowledge is both individual and shared, and constructivist methods rely heavily on students to manage their learning tasks and engage in interaction with their group members and Internet content.

Section 2.5.2 explained that cognitive and social constructivists are more concerned with how learners develop their cognitive processes and how to construct knowledge, and in the constructivist environments, learners are encouraged to use different tools for solving problems and justifying their solutions (Jonassen et al. 1995; Vrasidas, 2000). Jonassen (1992) indicates that constructivist teachers allow learners to have an active role in the evaluation process, and Vrasidas (2000) claims that evaluation of one's own work promotes self-reflective skills, which is another goal of constructivist learning. Lake and Tessner (1997) also note that offering learners the opportunity to evaluate their own work will help them gain ownership of the evaluation process, thus making them responsible for their own learning.

Constructivism has been widely accepted in maths and science education only since the early 1980s (Wheatley, 1991; Cobb et al. 1992; Simon, 1995; Thompson 1995; Fosnot, 2005). Although cognitive constructivism and social constructivism are differentiated, Cobb (1994) argued that these two approaches cannot be separated because they complement each other. Especially, he argues that maths learning should be viewed as both a process of constructing knowledge actively and a process of enculturation into the maths practices of wider society (Cobb, 1994).

Section 2.2.4 described the significance of a mediator in a SOLE, so it is worth noting the role of a mediator in constructivist environments. As reviewed in Section 2.5.2, mediation is a core concept of socio-cultural theory, and Kao (2010:117) argues that 'interaction with

teachers, peers or parents, with different levels of knowledge often leads to effective learning, which then encourages learners to move on to the next stage of learning or understanding' (Kao, 2010:117). Mediators are not just knowledge providers, and they can help students become self-directed learners (Kao, 2010).

Vrasidas (2000) indicates that constructivist teachers cannot recognise in advance all the specific understanding that each student will construct. What they can grasp is the broad area of knowledge, and they could provide opportunities for learners to develop the skills necessary to further explore a given domain. Kao (2010) states that peers with lower or equal abilities can also offer assistance within the ZPD. As reviewed in Section 2.5.2, knowledge is a human product, and it is constructed and expanded through the collaboration and social interaction with others (Vygotsky, 1978), so a good mediator can understand how to build on this connection. Thus, when a mediator assigns a task, if the learners could complete it alone without assistance, the learning is within their zone of actual development (ZAD). Anything that the students need to learn with the assistance and support from a teacher, peers, and the instructional environment, the learning takes place in the zone of proximal development (ZPD).

2.6 Research Gaps

As reviewed above, Mitra and a number of other educators have repeated the SOLE experiments in many different countries, but no research has been conducted in China. In the previous experiments, those researchers were interested in questions such as what and how much children can learn without subject teachers, and they placed emphasis on 'unsupervised learning' (Mitra et al., 2005; Mitra and Dangwal, 2010). Their results suggested that the absence of a teacher could sometimes encourage children to explore more 'bravely' than they would in their presence (Mitra and Arora, 2010), but there was little discussion about the changing role of teachers and parents in the SOLEs.

In conclusion, first, there is no research into how effective a SOLE can be incorporated into

curricula for different school subjects within an exam-oriented system in China or elsewhere. Different subjects have different characteristics and contents, so the researcher intended to find out whether SOLEs can be embedded in school curricula in China, and whether some subjects appear to be more susceptible to the effective use of SOLEs than others. Second, when a SOLE is introduced into a school curriculum, there is little research into the roles which teachers, students and parents play, and there is little research into how they adapt to their roles. Thus, this is also a research gap that needs to be. Third, there is no research into the attitudes of participates to the introduction of a SOLE in China, and the reasons for any change in their attitudes, so the researcher intends to fill it with this research.

According to Watkins et al. (2002:4), learning is an activity of construction, handled with others, and driven by learner's agency. Effective learning is all of these at their best, plus the monitoring and review of whether approaches and strategies are proving effective for the particular goals and context.

Watkins et al. (2002:5) tend to indicate that the outcomes of effective learning mainly involves such as 1) more connected knowledge; 2) wider range of strategies; 3) greater complexity of understanding; 4)enhanced action appropriate to goals and context; 5) increased engagement and self-direction; 6)more reflective approach; 7)more positive emotions and affiliation to learning; 8) more developed vision of future self as a learner; 9)greater facility in learning with others ; and 10)more sense of participation in a knowledge community. The definition of effective learning suggests that the effective learner should be: 1) active and strategic; 2) skilled in cooperation, dialogue and creating knowledge with others; 3) able to develop goals and plans; and 4) should monitor her/his own learning and is versatile across contexts (Watkins et al., 2002: 5). The researcher would refer to the above definitions to observe participants' behaviour in the SOLEs.

2.7 Chapter Summary

This chapter reviewed studies of learner autonomy, project-based learning, and Internet-assisted learning and teaching environments, confirming that the SOLE combines aspects of all three of these elements in an approach which encourages autonomous learning within cloud-based learning environments. Studies on the significance of a mediator in a SOLE underlined the need to observe and record teachers' roles in this SOLE study. The over-riding importance of the exam-oriented education system in China and the focus of teachers, students, and parents on the pursuit of high grades, highlighted the need to collect the students' examination results as an important data source in this study. In addition, it was clear that the researcher would have to work closely with the teachers to support them in planning the SOLE classes appropriately, and to ensure that the study did not negatively impact on the exam work.

The review of collaborative/cooperative learning and independent learning suggested that Chinese students tend to play a relatively 'passive' role in their 'traditional' classroom, so the researcher would need to observe how effectively students adapt to their new role when learning as part of a group in a SOLE. Bernstein's concept of 'framing' was identified as a tool for analysing interaction among students and with the teacher when Internet technology is introduced into the educational context. The review of social constructivism and scaffolding highlighted other important features of collaboration, including the fact that Chinese students are often described as very competitive. In addition, in considering how to analyse the learning outcomes of the SOLE, Watkins et al (2002) identified a number of characteristics that might be observed as indicative of effective learning. This literature review also summarised the earlier studies and current trends in research on the SOLEs, which helped the researcher to identify three research gaps in this field. The researcher would intend to observe whether some subjects appear to be more susceptible to the effective use of SOLEs than others within the exam-oriented system in China, and observe participants' roles and their attitudes to the SOLE. The next chapter will introduce the methodology in this study.

Chapter 3. Methodology

3.1 Introduction

This research aimed to investigate the effectiveness of a SOLE within a school curriculum (history and maths), the learning and teaching processes within a SOLE, and participants' attitudes towards a SOLE. From these three goals, a number of specific research questions and issues emerged.

This chapter introduces the research methodology used in this study and how it had guided data collection and analysis. Section 3.2 presents the research questions, and the following Section 3.3 and 3.4 set out the research philosophy and sampling techniques. Section 3.5 summarises the research methods, and the subsequent Section 3.6 and 3.7 will introduce the data collection and data analysis procedures. This chapter will conclude by explaining how the reliability and validity of the data were ensured, and how ethical considerations were taken into account (Section 3.8 and 3.9).

3.2 Research Questions

To achieve the three main aims of the research, the following three main research questions and related sub-questions were investigated.

1). How effective is a SOLE method within school curricula for different subjects?

   a) How effectively do SOLE and non-SOLE groups perform in different subjects?

   b) Are there any differences in homework and exam performance for different subjects?

   c) Are there any other learning outcomes other than those measured by exam performance?

2). What is the effect of the roles participants play in a SOLE?

   a) What roles do teachers, students and parents play in a SOLE?

   b) How do teachers, students and parents adapt to their roles?

   c) How effectively do students work in their new roles?

3). What are the attitudes of teachers, students and parents towards a SOLE?

   a) What are their attitudes before the introduction of a SOLE?

   b) What changes in attitudes are there based on their experience of a SOLE?

   c) What are the reasons for any change in attitudes?

To answer all these questions, the researcher contacted some schools to conduct this study, and then selected one school in which the headmasters and teachers were willing to support the researcher in carrying out this research. Details on how were the schools selected for contacting and other relevant information about research site will be introduced in Section 3.4.1.

3.3 Research Philosophy and Research Approach

(1) Ontology and Epistemology

Ontology and epistemology are two different ways of viewing a research philosophy. Ontology is the study of 'being', and it is concerned with 'what is there' and the nature of social entities and what exists (Al-Saadi, 2014; Vanson, 2014; Bryman, 2016). Epistemology is concerned with the nature of knowledge and different methods of gaining knowledge. For Crotty (1998), epistemology is a way of looking at the world and making sense of it, and for Bryman (2016: 24), epistemology 'concerns the question of what is (or should be) regarded as acceptable knowledge in a discipline'. Epistemology in general focuses on the questions 'what do you know?' and 'how do you know it?' (Vanson, 2014).

Ontology and epistemology provide the framework for a set of beliefs underpinning any particular approach to research. These sets of beliefs constitute a framework for conducting research, or a research paradigm, the most widely used of which are positivism (or objectivism) and interpretivism (or subjectivism) (Johnson et al.,2007; Raddon, 2010; Al-Saadi, 2014; Vanson, 2014; Bryman, 2016). Positivism assumes that reality exists independently of the thing being researched, and that knowledge is confirmed through the

senses (Bryman, 2016). Positivist studies usually adopt the deductive approach, which depends on quantifiable observations that can be measured, and in positivist studies, the observer is independent of the study (Bryman, 2016). Positivism does not allow for the subjective opinions of the researcher as the approach deals with verifiable observations and measurable relations between those observations (Raddon 2010; Vanson, 2014). Under positivism, the researcher would have greater opportunity to retain control of the research process, although it is inflexible because of direction often cannot be changed once data collection has started (Raddon, 2010). Conversely, Interpretivism rejects absolute facts and requires the researcher to grasp the subjective meaning of social action, and involves observers in interpreting. Interpretivism integrates human interest into research (Vanson, 2014; Bryman, 2016), and Raddon (2010) tends to call a researcher as scientist on positivism and detective on Interpretivism.

The research design of this SOLE study considered the ontological position because there was no right or wrong answer when data was collected from different participants depending on their role, values set or background. This study tended to adopt positivism because the researcher accepted observable phenomena based on data and facts as knowledge, and the author tried to avoid using subjective opinions to describe data result.

Furthermore, Wilson (2010) and Bryman (2016) sum up the difference between deductive reasoning and inductive reasoning. Deduction involves deducing a hypothesis (or hypotheses) based on an existing theory, and then arriving at a specific conclusion. If the researchers put forward a set of hypotheses for their research, and these hypotheses need to be confirmed or rejected during the study process, they should follow a deductive approach. For inductive reasoning, no theories or hypotheses are applied at the beginning of the research. The researchers first raise the research objectives and questions which need to be achieved during the research process, and after taking a series of detailed observations, the theory is generated out of the research (Saunders et al. 2012; Bryman, 2016).

As introduced above, the author had stated the research aims and questions before this SOLE research started, and she would use a series of observations to record and describe and analyse the findings that were being studied, so this research followed the inductive reasoning.

(2) Quantitative research

The quantitative approach is essentially about collecting numerical data to explain a particular phenomenon. Measurement, numerical data, and statistics are the main substance of the quantitative instruments. Bryman (2016:149) indicates that 'it is common for outlines of the main steps of quantitative research to suggest that a hypothesis is deduced from the theory and is tested'. However, 'a great deal of quantitative research does not entail the specification of a hypothesis, and instead theory acts loosely as a set of concerns in relation to which the social researcher collects data' (Bryman 2016:149). According to the research questions, it could be seen that the author did not make accurate predictions and did not determine cause and effect in this SOLE study. This study focused on describing situations in the classroom observations and participants' diary feedback. After participants answered questions administered through interviews or questionnaires, the researchers simply described the responses given. Thus, this study was not designed for hypothesis testing. As the author discussed above, this SOLE study was a descriptive study which used inductive reasoning and adopted an inductive reasoning approach, and the research process involved the following stages: 1) Research design; 2) Devise specific measures; 3) Select research site; 4) Select research subjects; 5) Collect data; 6)Process data; 7)Analyse data; 8) Conclusions.

Bryman (2016: 163) thinks that there are four distinctive preoccupations in quantitative research: 'measurement, causality, generalisation, and replication'. In this SOLE study, the researcher analysed parents' questionnaires with closed-ended questions and students' exam results using the quantitative approach. Quantitative methods assisted the researcher in preventing bias in gathering and processing research data, because the data collection procedures were objective and unitary. The detailed discussion of the validity of the

procedures will be introduced in Section 3.8. The researcher took great care to avoid her thoughts, attitudes and behaviour affecting the results. However, it was not enough to merely use the quantitative research in this SOLE study, because the quantitative data could not answer all research questions. Combining quantitative methods and qualitative methods in this study was necessary.

(3) Qualitative research

Qualitative research allows for flexibility throughout the research process. It is interpretative and usually emphasises words rather than numbers in the collection and analysis of data (Bryman 2016: 374), and it aims to record and analyse a deeper meaning and significance of human behaviour and their experience. Qualitative instruments can provide more in-depth information which cannot be obtained from numerical data gathered by quantitative means. Qualitative research can provide more valid data than quantitative research in investigating such things as the meanings people attach to their experiences. Qualitative methods allow flexibility in data collection, data processing, data analysis, and data interpretation. Also, qualitative methods enable the presentation of the phenomenon being investigated in a more holistic view. There are six main steps in carrying out qualitative research, 1) Identifying research questions; 2) Selection of relevant subjects; 3) Collection of relevant data; 4) Interpretation of data; 5) Conceptual and theoretical work; 6) Writing up findings (Taylor et al. 2015; Bryman 2016: 379).

It was still necessary to consider the critique of qualitative research. Bryman (2016:398) indicates that qualitative research is impressionistic and subjective, and it is not easy to replicate a study because there are hardly any standard procedures to be followed. The scope of the findings of qualitative investigations is restricted, as one case cannot be considered representative of all cases. Atieno (2003) also express a similar opinion, and he indicates that the findings of the qualitative research are not tested to discover whether they are statistically significant or due to chance, so the findings cannot be extended to wider populations with the

same degree of certainty (Atieno, 2009: 17). Moreover, qualitative research is criticised for lacking transparency in the analytical procedures (Moravcsik, 2014; Noble and Smith, 2014; Bryman, 2016). According to Moravcsik (2014), transparency is the cornerstone of social science, and it includes three dimensions: data, analytics, and production transparency. Noble and Smith (2014:2) indicate that qualitative research lacks transparency because the findings being merely a collection of personal opinions subject to researcher bias, and Bryman (2016:39) indicates that it lacks transparency because 'the process of qualitative data analysis is often similarly unclear'.

Nevertheless, despite the above criticisms, the qualitative approach still collected a highly valuable data in this research. Cohen (et al. 2011: 366) indicates the qualitative approach did indeed provide 'an in-depth, intricate and detailed understanding of meanings, actions, non-observable as well as observable phenomena, attitudes, intentions and behaviours'.

In considering the research questions and data would be collected, it could be seen that the qualitative approach was essential for this study. The researcher spent nine months to investigate the learning and teaching processes within a SOLE and participants' attitudes towards a SOLE, and the researcher used qualitative methods (e.g. semi-interviews, questionnaires with open-ended questions, classroom observations, and diary forms) to provide all participants with some level of freedom to appropriately or accurately express their thoughts, feelings and attitudes, rather than force them to select answers from a set of pre-determined responses. The qualitative methods gathered rich data to record participants' performance in the SOLEs and participants' changing attitudes towards it.

(4) Mixed methods
The researcher considered the strengths and weaknesses of quantitative and qualitative research described above, and opted for a mixed methods approach in order to collect and analyse quantitative and qualitative data in a single study, as this would offer a better

understanding of the research problem than either approach alone (Caruth, 2013; Bryman, 2016). There are four basic mixed methods designs:

1) Convergent parallel design: Collect and analyse quantitative and qualitative data at the same time, and mix the results during the overall interpretation;

2) Exploratory sequential design: Collect quantitative and qualitative data at different times, with qualitative data collection as the priority;

3) Explanatory sequential design: Collect quantitative and qualitative data at different times, with quantitative data collected first, followed by qualitative;

4) Embedded design: Collect quantitative or qualitative data within a quantitative or qualitative framework; (Caruth, 2013; Bryman, 2016)

In this SOLE study, the researcher used the convergent parallel design, because the quantitative and qualitative data had equal priority and could be collected simultaneously, although qualitative data accounted for a large proportion. The resulting analyses were then merged during interpretation. For example, the researcher collected the qualitative data for participants' diary forms and the quantitative data for exam results concurrently, analysed these two data sets separately, then merged the results for interpreting.

Triangulation design was adopted in this study to enhance the credibility of the findings. Yeasmin and Rahman (2012: 156) indicate that triangulation 'refers to the combination of two or more theories, data sources, methods or investigators in one study of a single phenomenon to converge on a single construct', and according to Richards et al. (2012: 308), a triangulation strategy 'brings qualitative and quantitative methods to bear on a research problem in a single phase in order to better understand it'. According to Guion et, al. (2002), triangulation design mainly includes data triangulation (using evidence from different types of data sources), investigator triangulation (more than one researcher), theory triangulation (different theoretical perspectives), methodological triangulation (using more than one option to gather data), and environmental triangulation (different locations or settings). The

researcher mainly adopted data triangulation and methodological triangulation in this study, and the validity of this qualitative research based on triangulation will be discussed in Section 3.8.

Thick description is also an important concept in the qualitative research. The term was introduced by British metaphysical philosopher Gilbert Ryle in 1949, and in 1973 anthropologist Clifford Geertz developed this concept in his The Interpretation of Cultures to characterise his own method of doing ethnography (Ponterotto, 2006). According to Holloway (1997:154), thick description aims to 'give readers a sense of the emotions, thoughts and perceptions that research participant's experience', and it refers to the detailed account of field experiences in which the researcher makes explicit the patterns of cultural and social relationships and puts them in context (Holloway, 1997). Ray (2011) indicates that thick description could provide enough background for understanding essential information so that a person outside the culture can make meaning of the behaviour. A thick description should involve accurately describing and interpreting social actions such as when and where the action took place, who performed it, and the intentions in doing so (Ponterotto, 2006; Davies, 2015). The reliability and validity of this study based on thick description will be discussed in Section 3.8.

(5) Ethnographic Research

Ethnography is a type of research methods through direct observation of people in a given environment over a period of time (Atkinston et al., 2007; Genzuk, 2003; Singer, 2009). Ethnography was popularised by anthropology but is widely used in social sciences such as sociology, psychology, sociolinguistics, and even the business world (Genzuk, 2003).

Different academics suggest different definitions of ethnography. According to Maanen (1996), ethnography typically 'refers to fieldwork conducted by a single investigator who 'lives with and lives like' those who are studied, usually for a year or more'. Fetterman

(1998:1) indicates that "ethnography is the art and science of describing a group or culture. The description may be of a small tribal group in an exotic land or a classroom in middle-class suburbia'. Creswell (1998:18) points out that 'ethnography is a description and interpretation of a cultural or social group or system. The researcher examines the group's observable and learned patterns of behaviour, customs and ways of life'. Singer (2009:191) agrees with Lindlof and Taylor who call ethnography as 'a holistic description of cultural membership'.

Ethnographic studies prefer the quality of the data, not the quantity. Therefore it is crucial to choose the right contexts and participants depending on what the research aims are (Atkinston et al., 2007; Singer, 2009, Reeves, 2013). The cycle in ethnographic research begins with the data collection, and the research methods mainly include participant observation, interviews and surveys (Schensul et al., 1999; Genzuk, Atkinston, 2007; Nurani, 2008). All of these methods can be very useful in obtaining an in-depth understanding of the design problems. According to Genzu (2003), typical ethnographic research uses three kinds of data collection--interviews, observation, and documents. And then the data of quotations, descriptions, and excerpts of documents will be produced, resulting in one product -- narrative description (Genzu, 2003). Hammersley (1990) points out that the narrative mainly includes charts, diagrams and additional artefacts that help to tell 'the story'.

Although Ethnographic research relies on personal experience and possible participation, ethnographers depend primarily on observation (Watson and Till, 2010; Shah, 2017). Genzuk (2003: 2) points out that participant observation 'simultaneously combines document analysis, interviewing of respondents and informants, direct participation and observation, and introspection'. Participant observation could help the researcher to develop an insider's view of what is happening (Genzuk, 2003; Watson and Till, 2010; Reeves et al., 2013; Shah, 2017).

Ethnographers generally make a majority of key decisions within an ethnographic study, and s/he is responsible for designing, conducting and analysing the study, so it is essential that ethnographers need to be very highly-skilled to avoid all the potential pitfalls (i.e. bias and mistakes) (Nurani, 2008; Reeves, 2013) . Their skills and experience will be helpful to make sure the study is representative, accurate and fair. In order to learn about certain things in participants' lives, the ethnographers need to spend an extended period of time amongst a group/society and try to observe and understand what is being studied through the participants (Atkinston et al., 2007; Nurani, 2008; Shah, 2017). The possibility for a researcher to become a full participant in an experience will depend partly on the nature of the setting being observed (Genzuk, 2003).

Like any other research method, ethnographic research also has its strengths and weaknesses. Strengths of ethnographic study are: as introduced above, ethnography mainly uses qualitative research instead of quantitative research, so it depends on the researchers' observations without limited choices in answers. The results will be detailed and in-depth, and ethnographers could identify unexpected issues that the researcher might not have encountered in quantitative research (Atkinston et al., 2007; Nurani, 2008).

Weaknesses of ethnographic study include that: First, it takes much longer to generate and analyse all the findings, so the cost of conducting ethnographic research is typically much higher than conducting other studies. Second, unlike most quantitative researches that can be completed even with an impersonal relationship, ethnography may require researchers to create rapport with his subjects (Genzuk, 2003). The success of an ethnography research greatly depends on the openness and honesty from participates (Arnold and Brennan). Third, no matter how objective the researchers try to be, cultural bias or ignorance may still influence their perspectives (Nurani, 2008; Reeves, 2013). Fourth, ethnography is usually a field study from a certain setting so that the result might only be applicable to that single context (Nurani, 2008).

Nurani (2008:447) indicates that despite the limitations of the ethnographic research, it has benefits for research in naturalistic settings such as classroom research, because its observational technique that allows the researcher to record the behaviour as it occurs. In this study, the researcher spent about nine months to investigate the learning and teaching processes within a SOLE and participants' roles and attitudes towards a SOLE. Ethnography provides me with the chance to observe and analyse these situations in a SOLE. In this study, the researcher could not be a full participant in an experience, because the researcher could not become a participant (student/teacher/parent) to have the same experience in the setting as them. However, as an observer, the researcher participated as a mediator in the class and thereby developed the perspective of an insider in this study. The researcher obtained an in-depth view of the participants and how they went about completing the SOLE tasks. The researcher used participant observation, interviews and surveys to conduct this study, these methods helped the researcher built up a good rapport with teachers, students and parents, and also brought the researcher a deeper understanding of the design problems.

3.4 Research Sampling

Sampling methods fall into two broad categories: probability and non-probability (Cohen et al., 2011; Bryman, 2016). In probability sampling, 'a sample that has been selected using random sampling and in which each unit in the population has a known probability of being selected' (Bryman, 2016: 694). In non-probability sampling, sampling group members are selected in a non-random manner, 'some members of the wider population definitely will be excluded and others definitely included' (Cohen et al., 2011:153). Therefore, 'it implies that some units in the population are more likely to be selected than others' (Bryman, 2016: 693).

Non-probability sampling methods include 'convenience sampling, quota sampling, purposive sampling, dimensional sampling and snowball sampling' (Cohen et al., 2011:156). Devers and Frankel (2000) think purposive sampling methods are designed to improve understandings of selected individuals or groups' experiences, and 'those sampled are relevant to the research

questions that are being posed' (Bryman, 2016: 694).

The researcher in this SOLE study targeted a particular group, so the non-probability sampling method was used. In this SOLE study, the researcher aimed to investigate the effectiveness of a SOLE within a school curriculum (history and maths), the learning and teaching processes within a SOLE, and participants' attitudes towards a SOLE. It was helpful to work with the same teacher to observe the behaviour and achievements of students in the SOLEs and the conventional lessons, so the researcher deliberately selected participants for research by using purposive sampling strategy. In the following sub-sections, the researcher will introduce the process of sampling in data collection and details of participants.

3.4.1 *Research Site*

The researcher defined the target population first. As with the research gaps described in Section 2.5, in this SOLE study the target population should consist of participants residing in China. Then, the researcher chose the sampling frame, and the sampling frame was an extensive list of China junior high school students. As described in Chapter 1, initially SOLE studies were mainly conducted in some rural areas which were in poor conditions, and then many studies were conducted in high-resource settings (Mitra 1999; Mitra et al. 2005; Dangwal et al, 2006; Mitra and Arora, 2010; Mitra and Dangwal, 2010). In this SOLE study, the researcher had to choose a school which can provide high-quality facilities to support students in completing their SOLE tasks, because the researcher was not able to provide all types of equipment that were needed in a SOLE. The availability of convenient transportation, and knowledge of and familiarity with the area were additional considerations for the researcher.

The researcher conducted this SOLE study and collected relevant data in a junior high school which is situated in Xining city, Qinghai province. There were 87 junior high schools in Xining. The researcher contacted seven schools through e-mail and phone in this region and

communicated the research intentions to headmasters and teachers, four headmasters of these seven schools politely refused the researcher's application, they hinted that Internet-based learning might be time-consuming and even affect the result of students' exam, so they could not accept the application from the researcher. One headmaster was interested in this study, but he told the researcher that he could only allow the researcher conducted this study for two months first, if students improved their exam results in the mid-term examination, this SOLE study could proceed. Otherwise, it should be stopped. His suggestion was incompatible with the research plan, so the researcher regretfully declined this school. The headmasters from School A and another school did not refuse the researcher, and the researcher selected School A as the research subject because 1) the teachers were willing to support the researcher in conducting this SOLE study; 2) this school could provide a good environment with laptops and broadband connection for students; 3) good possibilities of access and transportation to and from the schools. School A opened in 1968 (Figure 3.1 and 3.2), in 2014 had approximately 1800 students and 132 staff members. Schooling starts at Seventh-grade and lasts for 3 years. There are 10 classes in each grade, and the range of student number in a class is approximately 55 to 65.

Figure 3.1: School A (1)

Figure 3.2: School A (2)

3.4.2 *Main Participants*

[Students]

In this SOLE study, the minimum sample size was determined by the statistical analysis the researcher proposed to do.The researcher took into account the response rate of participants' feedback, the range of subjects taught, and the number of laptops available, and then discussed these considerations with the headmasters and teachers. The researcher finally selected a class in the eighth-grade with 58 students (57 after Nov. 2014) as the SOLE group, and selected another class with 61 students as the non-SOLE group for history observation (both classes were taught by history Teacher A). The SOLE group for maths lessons and history lessons was the same class, and the non-SOLE group for maths lessons was a class with 60 students in the same grade (both classes were taught by maths Teacher B). Students from the seventh-grade had just entered the junior school from a primary school, the headmasters and teachers thought these students needed to give themselves some time to adjust and adapt to the new environment, so it would not have been appropriate for these students to take part in the study. Students from the ninth-grade would sit for the high school entrance exam next academic year, the headmasters and teachers worried that if the SOLE research affected the students negatively, their exam performance would be directly affected

by this research, so these students could not be the research subjects. Thus, the students from the eighth-grade were the optimal choice. Further details of these students will be introduced in Chapter 4 and 5.

[Teachers]

There were four history teachers and five maths teachers in the eighth-grade. After communicating with these nine teachers through a semi-interview (Appendix B), history Teacher A and maths Teacher B proved to be more supportive of the SOLE method and they were willing to engage in this study. Teacher A and Teacher B showed more interest towards this study and they said they could timely share their perspectives in this SOLE study, whether their attitudes would be positive or negative. More importantly, they said they were willing to provide the researcher diary feedback after each class, and they did not mind the researcher observing all SOLE classes in the classroom during the study. Thus, they were invited as the key participants in this research.

Teacher A (age 56, Bachelor's degree in Education) was the director of the history department with almost 35 years' teaching experience. She was responsible for the teaching and teacher development in this school, such as instructing the work of the interns and initiating research topics for new teachers. She was very familiar with her conventional teaching method, but she still expected to use the SOLE method to help students improve their achievements. She was interested in learning via the Internet, and she believed if students could use network resources correctly, the SOLE methods would be more successful than the conventional form of teaching. Teacher A wanted to try something new before she retires.

Teacher B (age 32, Bachelor's degree in Mathematics) started to teach in this school after her graduation from one of the universities in Xining. She had almost 10 years' teaching experience and she was also the class tutor for the SOLE class. She received some in-service teacher training around seventy hours each year for professional development. She was

interested in the SOLE methods because she thought that use of the internet for learning was becoming more common, and she hoped that her students could learn maths knowledge in a more vivid way. However, she admitted that she worried that students' grades would deteriorate in a SOLE.

[Parents/ Guardians]

This research was completed in a junior high school, and the age of students in eight-grade is 13-14. Considering the Child protection issues, school leaders, teachers and the researcher all thought that consent from their parents or guardian was required before the start of this study. Parents had the right to call the provincial education departments to file a complaint if they were not satisfied with the school's teaching situation, to avoid the possible trouble, it was necessary to keep parents informed of the research arrangement and results. In addition, it was hoped that parents could support their children to learn via the network.

The researcher held a meeting with Teacher A, Teacher B, 58 students and their parents together before this research started. The researcher presented a detailed description of the SOLE research, including the purpose of this study, the length of research time, course selections, the reasons to collect questionnaire/diary feedback, usage of the data, risk assessment, and terms for the withdrawal. Then the researcher also told them this was only used for personal study and research, not for any business purpose. These parents asked the researcher many questions about SOLEs, and the researcher answered each question patiently and carefully. The researcher avoided providing any false and misleading information as much as possible and did not impose pressures on participants, so the researcher tended to believe that this presentation did not affect the data from participants. They also read and signed the translated Chinese versions of 'Participant Information Sheet' (see Appendix I) and 'Consent Form' (see Appendix J). Then, a questionnaire regarding parents' comments on the Internet-based learning was handed out and collected on the day (see Appendix A).

[The researcher]

A lot of the preparatory work had been done by the researcher before gaining access to the research site. In the research process, the researcher organised the whole project and guided the students and teachers as they learned to work in a SOLE. In each SOLE classroom observation, as a classroom observer, the researcher walked around in the classroom to observe students' activities and record whether students were accessing unrelated material or she stood somewhere quietly observing the class and made notes from time to time (Appendix H). The researcher did not intervene in students' work unless students put up hands to ask for help. In the non-SOLE group, in order to record what questions the teacher asked and how students solved them, the researcher just sat at the back of the classroom and kept silent to observe teachers' and students' behaviour while the classes went on, without any intervention.

After each class, the researcher had to send and collect diary forms from the teachers and students for data analysis, and also needed to help the teachers to correct students' homework. The researcher had a discussion with the teachers after each class to heighten sensitivity to students' reflections, such as chatting with them about students' performance in the class, and asking the teachers to complete their diary form the same day. The researcher used her interpersonal skills to build trust and rapport with all participants, she tried hard to offer help to the teachers and students whenever possible, and shared learning experiences with the participants. For example, the researcher tried to boost the confidence of the students who did not complete SOLE tasks in class, and encouraged them to find more ways completing tasks next time. In addition, when the teacher and students had difficulties with Algebra classes, the researcher also tried to find out the reasons and make further adjustments when designing the questions they were asked. Interaction of this kind would affect attitudes and the way teachers and students worked.

In this study, the researcher had a responsibility to behave ethically and honestly in the course of the research. The researcher had the same amount of contact with each teacher, and

maintained neutrality in classroom observations and data analysis. The researcher remained careful and patient when collecting data, and was as objective as possible when analysing and interpreting. In order to avoid bias in this study, the researcher timely shared her notes with two teachers for ensuring her observation and interpretations seemed to be representative of their perspectives. The researcher also followed the triangulation design and thick description (see Section 3.3) to support her interpretations. The researcher adopted the role of counsellor, mediator and facilitator, rather than instructional designer, administrator of teaching and transfer of knowledge. More specific details of the researcher's activities will be provided in Chapters 4 and 5.

3.4.3 *School Curricula*

One of the research questions of this study was 'How effective is a SOLE method within existing school curricula for different subjects?', so it was necessary to select at least two curricula as the research samples. As discussed in Chapter 2, in a Chinese junior high school, maths, Chinese language, English, chemistry, physics, biology, history, geography, and politics are all compulsory (Kirkpatrick and Zang, 2011:37). However, Chapter 1 summarised different subjects have different characteristics and contents, and different ways of thinking are applied in different curricula, so it was important to select at least two different types of subjects for observing. After having discussed with the principals and directors of different subject department, and considered the feasibility, practicality, time and cost, we selected history and maths as the research samples.

This SOLE research was conducted over two semesters, and the students had one history SOLE and one maths SOLE class each week. Based on the weekly curriculum schedule, in Semester one (Sep. 2014 - Jan. 2015), the researcher observed 10 History classes and 7 maths classes in the SOLEs (Table 3.1). In Semester two (Mar. 2015 - May. 2015), the researcher observed 10 history classes and 13 maths classes in the SOLEs (Table 3.2). The detailed course topics for each lesson will be provided in Sections 4.2 and 5.2.

Semester One:

Date	Lesson	Date	Lesson
19.09.2014	History	13.11.2014	History
26.09.2014	History	18.11.2014	Maths-Algebra
08.10.2014	Maths-Plane Geometry	20.11.2014	History
10.10.2014	History	25.11.2014	Maths-Algebra
17.10.2014	History	28.11.2014	History
22.10.2014	Maths-Plane Geometry	03.12.2014	Maths-Algebra
24.10.2014	History	04.12.2014	History
31.10.2014	History	05.01.2015	Maths-Algebra
10.11.2014	Maths-Plane Geometry		

Table 3.1: SOLE course arrangements in semester one

Semester Two:

Date	Lesson	Date	Lesson
05.03.2015	Maths-Plane Geometry	17.04.2015	History
06.03.2015	History	23.04.2015	Maths-Plane Geometry
12.03.2015	Maths-Algebra	24.04.2015	History
13.03.2015	History	04.05.2015	Maths-Plane Geometry
18.03.2015	Maths-Algebra	11.05.2015	Maths-Plane Geometry
26.03.2015	Maths-Algebra	14.05.2015	Maths-Plane Geometry
27.03.2015	History	15.05.2015	History
01.04.2015	Maths-Algebra	21.05.2015	Maths-Algebra
03.04.2015	History	22.05.2015	History
08.04.2015	Maths-Algebra	27.05.2015	Maths-Algebra
10.04.2015	History	29.05.2015	History
15.04.2015	Maths-Plane Geometry		

Table 3.2: SOLE course arrangements in semester two

3.5 Research Techniques

In this study, the research techniques, and the data gathered using them, are summarised below:

[Students group]: Diary forms; Semi-structured interviews; Homework; Three exam scores;

[Teachers group]: Semi-structured interviews; Reflective diary forms;

[Parents group]: Questionnaires

[Researcher]: Classroom observations reports; Field notes;

[Assistive Equipment]: Audio recording

3.5.1 *Semi-structured Interviews*

Boyce and Neale (2006: 3) define in-depth interviewing as 'a qualitative research technique which involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program or situation'. It is useful when the researchers want 'detailed information about a person's thoughts and behaviours or want to explore new issues in depth' (Boyce and Neale, 2006).

Bryman (2016) summarises three types of interview, including the structured, unstructured and semi-structured interview. In a structured interview, each interviewee needs to answer a series of pre-determined questions in the same order, and receives quite the same interview stimulus as any other. In an unstructured interview, the researcher will not lead the interviewees in any particular direction during the interview, and all interviewees can discuss any contents they want, for as long as they want (Bryman, 2016). However, as a result, it can be associated with a high level of bias because it does not have predetermined set of questions. In a semi-structured interview, on the other hand, the interviewer has a list of questions, but the process is flexible. Interviewees have the opportunity to use their own words when talking about the topic, but the researcher still covers the main areas that she would like to control. Questions may not be asked in exactly the same order, and additional questions might be asked during interviews to define or further expand certain issues (Bryman, 2016).

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Boyce and Neale (2006: 3-4) describe the limitations of interviews as 1) Prone to bias; 2) Can be time-intensive: 3) Interviewer must be appropriately trained in interviewing techniques; 4) Not generalizable. However, interviews still have many advantages. The interviews can provide much more detailed information than what is available through other data collection methods. Researchers can control the process of data collection and have a chance to clarify certain issues during the interview process. Moreover, interviewees may feel more relaxed having a conversation with the researcher in a comfortable environment.

[Teachers]

There were three types of participants in this SOLE study (Section 3.4.2), and the researcher used semi-structured interviews in two of them. The first group was the history and maths teachers in eighth-grade in this school. History Teacher A and maths Teacher B who were involved in the SOLE class were the main participants.

According to the research question-3, the researcher wanted to know teacher's attitudes towards a SOLE. As mentioned in Section 3.4.3, we had selected history and maths as the research samples, so next step the researcher needed to select two teachers as the participants in this SOLE study. The researcher had a short interview with four history teachers and five maths teachers in eighth grade to investigate their attitudes towards an Internet-based learning environment. These teachers told the researcher that they preferred to do this interview with their colleagues together, rather than one-on-one conversations, so the researcher used group interview for making them feel more relaxed. The researcher used a standardised interview schedule with set questions which all of the teachers were asked, and the teachers were encouraged to talk freely about whatever they thought relevant. The Interviews took place in an office and lasted around 30 minutes (see Appendix B). History Teacher A and maths Teacher B proved to be more supportive of the SOLE method and they were willing to engage in this study.

For the main participants Teacher A and Teacher B, the semi-structured interview also occurred in the classroom when students did their SOLE tasks, after the SOLE class, or on the way back to their office. In interviews where there were no audio-recorders used, or when teachers were not willing to allow the researcher to record their comments on sensitive topics, the researcher first took notes of some statements verbatim, and then wrote up a complete version immediately afterwards. The length and format of the interviews depended on the convenience of the interview sites and the contents of conversations.

[Students]

When the researcher collected students' diary feedback after the SOLE class, some students did not always submit it because, they claimed, they forgot to do it, or they were too lazy to do it, or they lost their diary forms. The researcher told them if they did not mind talking face-to-face, the researcher could spend some time during their class break to listen to their feedback. The researcher also used semi-structured interviews to record the conversations. Interviews with some of these students who did not submit their diary forms basically lasted around 5 minutes, sometimes the researcher had conversations with students one-on-one, and sometimes other students also joined in the fun to express their opinions on the questions. Most of the time the researcher audio-recorded the conversations, but some students were not comfortable with this way, so an alternative was to write down their words in the field notes during or after the conversations. All questions in the semi-structured interviews were consistent with the questions listed on their diary forms, and when a student tended to express more perspectives, the researcher always listened to her/him with great patience and gave a response.

In total, the researcher collected a total of three hours audio-recorded interviews and did the field notes form apart from those hours. For those interview recordings which were only written on the field notes, the researcher tried to recover the data shortly after the interview when the memory was still fresh, or every evening when the researcher returned home.

3.5.2 *Questionnaires*

Cohen et al. (2011: 377) indicate that the questionnaire is a widely used and useful instrument for collecting survey information, providing structured, often numerical data, being able to be administered without the presence of the researcher, and often being comparatively straightforward to analyse. The researcher used the questionnaire method to collect some useful data about parents' comments on Internet-based learning (see Appendix A and G). The questionnaire saved the time for collecting data, met the low-cost requirements, and was a more objective way of gathering data than interviews.

Following the staged sequence for planning a questionnaire (Cohen et al., 2011), the researcher first decided the purposes of the questionnaires, and then decided the participants who should answer these questions. Then, the researcher chose questions which would help meet the objectives of this study, and showed the preliminary questionnaires to Teacher A and Teacher B for advice.

The researcher conducted a pilot survey before the actual survey, and administered the questionnaires to a small group of target participants who were not included in the main survey. The participants in the pilot survey included seven teachers in this school, two relatives of the researcher, and three colleagues of the researcher's mother. All these twelve participants had a child around 14 years old, which was consistent with the participants in the main survey. The results of the pilot survey provided the researcher with some new thoughts to revise the preliminary questionnaire, such as adding two open questions in the final questionnaire (Appendices A and G). The results also showed that these two questionnaires were likely to be effective in achieving the objectives of this SOLE study.

The researcher held a meeting with Teacher A, Teacher B, 58 students and their parents together before this research started (Section 3.4.2). Before the end of the meeting, the researcher hand out a paper questionnaire with five closed questions and two open questions

to parents to record their attitude towards SOLEs (Appendix A). On the last day of the SOLE experiment, a paper questionnaire was sent home with the student for their parents to fill in. It included three questions on the history lessons (two closed questions and one open question), and five questions on maths lesson (four closed questions and one open question). There were different numbers of questions because questions on maths lessons were asked based on geometry and algebra, respectively (see Appendix G).

3.5.3 *Classroom Observation*

Cohen et al. (2011: 456) indicate that observation is 'looking (often systematically) and noting systematically (always) people, events, behaviours, settings, artefacts, routines and so on', and it offers a researcher the opportunities to collect 'live' data from naturally occurring social situations (Cohen et al., 2011). Observation can be structured, semi-structured or unstructured (Bryman, 2016; Cohen et al., 2011). In this SOLE study, the researcher adopted a structured observation to record participants' behaviour for observing students' learning initiative, learning process, and learning outcomes in the class. The observations occurred in two different groups as follow.

[SOLE Group]

The researcher observed 20 history classes and 20 maths classes in the SOLEs (Section 3.4.3). In each class, the researcher observed and recorded the following aspects on the observation sheet (Appendix H): 1) the date; 2) main discussion topic of the day; 3) groups setting; 4) number of laptops used for the day; 5) questions posed by the teachers; 6) positive aspects; 7) negative aspects; 8) others. Section 4.6 and 5.6 will show seven examples of observations taken during the SOLE lessons.

At the start of the study, the researcher tried to record their learning process via videos, to observe what they did in a SOLE, but it was hard to achieve a satisfactory result. Students had to complete their SOLE tasks and discussion in a group with 4-6 people, and the big classes

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(58 students) made the classroom noisy, so students' words could not be made out. The researcher discussed this situation with the teachers, and then we took four cameras into the classroom, but most students were unwilling or uncomfortable when we did it, especially those groups who were closer to the cameras, they could not relax and throw themselves into the learning. The researcher should provide the participants with a comfortable environment and not force them to do anything, so the researcher removed the cameras and just used field-notes as described above.

According to the research design, the researcher and teachers should not intervene in students' learning process when they did the SOLE tasks, so the researcher kept silent and only walked around the classroom or stood in the corner to observe students' work and take some field notes unless students asked for help to solve problems. Meantime, the researcher also observed the teachers' behaviour in the SOLE class, to record whether the teacher offered support to students and if the interventions could solve problems from students. Examples will be discussed in Chapters 4 and 5.

 [Control Group]

To compare the difference between the SOLE methods and conventional methods, the researcher also observed the non-SOLE classes, taught by the same teachers. The researcher used the same observation sheet to record activities in the non-SOLE class as in the SOLE class. In the control group, the researcher only sat at the back of the classroom to take field-notes, and did not need to deliver any interventions to students, because the teachers controlled the whole class. Sometimes teachers focused on assessing students' homework and asking them to do more exercises on paper in the class, so there was nothing to record in these lessons. In total, the researcher observed 15 history classes and 14 maths classes in the non-SOLE group. A specific description of classroom observations in the non-SOLE group will be introduced in Section 4.3.2, 4.3.4, 5.3.2, and 5.3.4.

3.5.4 *After-class Diary Forms*

Bryman (2016:238) indicates that there are three main ways in which the term 'diary' has been employed in the context of social research: 1) as a method of data collection (researcher-driven diary). The researcher designs a structure for the diary and then invites a sample of diarists to complete it so that they write down what they do with their activities; 2) as a document. The diaries in this context were produced spontaneously by the diarist and may be used as a source for analysis; 3) as a log of the researcher's activities. Here the diaries are recorded by the researchers as a memo to record what they do at different stages in learning.

In this study, diary forms can be used as an effective channel of communication between the researcher and participants for discussing their learning process and experiences in a SOLE. The researcher tended to guide students to be aware of how they learn in a SOLE, and help two teachers reflect on classroom activities and their experiences for further planning effective classes. The researcher used the 'researcher-driven diary' to analyse participants' comments for the SOLE. After each class, the researcher provided a diary form to each participant, including the Teacher A and B and students, and invited them to answer some pre-determined questions about their experiences in the SOLEs of the day (Appendices E and F). Normally, the feedback was collected by the next morning, and if the SOLE classes were conducted on a Friday, their diary forms were collected on the following Monday morning.

[Students' Diary Form]

The researcher observed 20 history classes and 20 maths classes in the SOLEs, and collected diary forms in those 40 classes. To better compare students' attitudes for history lessons and maths lessons in the SOLEs, same fixed questions in the diary form were asked, and some new questions were added depending on the learning contents of the day. Sections 4.4 and 5.4 will provide a detailed description of this.

To encourage the students to be honest with the researcher, they were allowed to submit their diary forms anonymously, but if they would like to further communicate with the researcher and teachers, they could write their name on the form.

[Teachers' Diary Form]

The researcher also collected the reflective diaries from Teacher A and Teacher B after each class. The diary form for teachers also included some pre-determined questions about students, lesson objectives, classroom management and so on, and the specific questions asked in the form will be stated in Section 4.4.2. It was important that teachers could record and evaluate students' class performance via the diary form, and a diary form was a useful tool to help them carry out self-reflection and self-evaluation on teaching. Teachers recorded and analysed what the pre-determined questions asked about in the lesson, and the diary form could help them make improvements in teaching strategies where necessary.

3.5.5 *Homework*

As Hong et al. (2009: 269) concluded, 'homework is a frequently used educational activity, and homework assignments support for academic learning and the development of academic skills'. In this research, after each class, both Teacher A and Teachers B always assigned a set of tasks to students and asked them to complete them outside the class, to consolidate the key content they had learned in the class. Thus, the researcher believed that comparing the results of homework for the SOLE group and non-SOLE group could help the researcher analyse students' learning outcomes with different learning methods.

Students had to finish their homework distributed by the teachers after each lesson and hand it in the next morning. All students in both the SOLE group and control group had to complete the homework independently with the same questions, and then teachers and the researcher corrected their assignments.

In this junior high school, almost all teachers did not have enough energy to spend time giving the completed homework a grade or providing detailed feedback on students' exercise books. For example, Teacher A taught a class once a week and had two classes with a total of 119 students, and then she needed to grade 238 pieces of homework each week. Therefore, the teachers only checked whether the homework had been done, and put a tick next to right answers and a cross next to wrong ones. Students had to revise their wrong questions, and teachers would check it when students submitted their homework (exercise books) next time. Occasionally, teachers recorded the questions which were answered wrongly by most of the students and discussed them with students in their practice lessons. This situation seems like a common way in a majority of junior/senior high school in China.

In this SOLE study, Teacher A and Teacher B gave the researcher a list of standard answers, and then the researcher checked students' homework with the teacher together in the office. If the researcher was unsure about their answers, the teacher would provide help to check it. The researcher and the teacher discussed student' performance while they checked their homework. Teacher A and Teacher B had a rich experience in teaching, so they could confirm whether students had understood courses by the homework results. The assessment of homework assignments for different groups will be discussed in Section 4.5.1 and 5.5.1.

3.5.6 *Examinations*

As introduced in Chapter 2, achieving excellent exam scores were very important to all participants under the examination-oriented education system in China, so exam scores were also key data that allowed the researcher to compare students' performance in the SOLE group and non-SOLE group. Examinations can be 'written, oral, practical, interactive, computer-based, dramatic, diagrammatic, pictorial, photographic, involve the use of audio/video material, presentation and role-play' (Cohen et al., 2011: 488).

Standardised exams are administered and scored in a standard manner, i.e. the questions, exam conditions, scoring procedures, and interpretations are consistent (Popham, 1999; Olson and Sabers, 2008). Olson and Sabers (2008: 423) indicate that 'standardized tests were those in which the conditions and content were equal for all examinees'. In contrasts to the standardised tests, non-standardized tests are administered under significantly different conditions. The examinations in this SOLE research met the definition of a standardised test. Xining municipal education bureau generated the examination papers, and it meant that all Eighth-grade students in Xining took the same exams at the same time, and teachers graded them in the same way. Standardised exams are fairer than non-standardised tests, because every student gets the same test and the same grading system. Section 4.5.2 and 5.5.2 will set out the detailed analysis of students' exam results with two research groups.

In this junior high school, an examination is intended to measure a student's knowledge and mastery of a subject. During this SOLE research, students took three history exams and three maths exams in November 2014, January 2015 and May 2015, and all six examinations were administered on paper in writing. These six examinations were closed-book tests (multiple choice and essay for history exams; maths questions for maths exams), and students were required to rely upon memory to respond to the exam questions.

3.6 Data Collection

This research was managed in four stages (Table 3.3). In the preparatory stage (Aug. 2014), the researcher discussed with the principals and directors of the different subject department, and then we selected history and maths as the research samples. In the second stage (Sep.2014), the researcher collected semi-structured interview data from teachers for selecting main participants (Teacher A and B) and questionnaire data from parents (Section 3.5.1 and 3.5.2). Meanwhile, the researcher found that history Teacher A taught two classes and Teacher B taught three classes in eighth-grade, in order to ensure students in the SOLE group and the non-SOLE group were almost at a similar level, the administrative assistant of this junior high

school sent the researcher the average scores for each class in this grade for the previous school year to help the researcher and two teachers to choose suitable research participants (students). In the semester one (Sep.2014—Jan.2015), the researcher observed the SOLE and non-SOLE lessons in the classroom, and collected diary feedback data from students and teachers, students' homework, occasional semi-structured interviews with teachers and students, the researcher's field-notes, and two examinations in Nov.2014 and Jan.2015 (Section 3.5). In the semester two (Mar. 2015—May.2015), the researcher used the same methods to collect data, but students only took one exam in May. 2015. After finishing the last one SOLE lesson, the researcher also collected a questionnaire from the parents to analyse any changes in their attitudes toward a SOLE.

Stages	Main Participants	Quantitative data	Qualitative data
One 18.08.2014--29.08.2014	Principals Directors Researcher	N/A	N/A
Two 01.09.2014-17.09.2014	Teachers Assistant Parents Researcher	Exam scores Questionnaires (closed questions)	Semi-interviews Field-notes Questionnaires (open questions)
Three 19.09.2014-15.01.2015	Students Teachers Researcher	Exam scores	Classroom observation Diary forms Homework Semi-interviews Field-notes
Four 01.03.2015-29.05.2015	Students Teachers Researcher Parents	Questionnaires (closed questions)	Classroom observation Diary forms Homework Semi-interviews Field-notes Questionnaires (open questions)

Table 3.3: Research stages and mixed methods for this study

3.7 Data Analysis

The obtained data had to be organised and processed for analysis. It could be seen that in this study most of the data were qualitative data. Cohen et al. (2011: 537) indicate that 'qualitative data analysis involves organising, accounting for and explaining the data', and it is usually heavy on interpretation.

The qualitative data were very rich in this research, and these data generated 'thick descriptions' within the context (see Section 3.3). Interview data could be transcribed because transcription can offer 'important detail and an accurate verbatim record of the interview' (Cohen et al. 2011: 537). The researcher considered the time, cost, and necessity of transcription, and then chose to write the analysis of the data directly from the audio recording, and selected out the key information directly from the original source rather than from the mediated source of transcription (Cohen et al. 2011). In order to avoid cherry picking in the process of conducting this study, the researcher reported her results obtained in this study with both positive and negative findings for guaranteeing that they were accurate and worthwhile, not only selected the results made them seem most credible. Diary forms data made up a large proportion of this research, so the researcher numbered these anonymous forms in sequence. The researcher summarised and described some typical comments which were extracted from their feedback based on different aspects, such as in positive, neutral and negative ways (see Section 4.4 and 5.4). In order to avoid forgetting the important details presented throughout participants' observation, the researcher also used the field notes to capture some insights, reflections or memos on classroom observation (see Appendix H) and record students' homework assessment into her notebook, such as what keywords students used for searching answers, the numbers of students who changed their group in a SOLE, the summary of the intervention situation, the problems in their homework, etc. These field notes were intended to be read by the researcher as evidence to produce an analysis of the phenomenon being studied, for example, the researcher could understand how much change had occurred and who had experienced change as the course progresses. In the report, the researcher would describe

these notes clearly when needed.

In this study, the quantitative data from the questionnaires consisting of closed-questions and exam scores were numerical. According to Cohen (et al. 2011), some of the analytical software can be utilised to assist with analysis of quantitative data. The researcher entered the data which collected from the questionnaires into a spreadsheet and used Microsoft Excel to run a basic descriptive statistics, and the results were displayed in the pie charts for comparing the proportion of data in each category (see Section 4.4.3 and 5.4.3). On the other hand, in order to compare the differences of exam results between the SOLE group and non-SOLE group, the researcher used the paired samples t-test and independent samples t-test in SPSS to analyse the difference of students' exam results in each group (see Section 4.5.3 and 5.5.3).

3.8 Reliability and Validity

Reliability and validity are important criteria for establishing and evaluating the quality of social research (Bryman, 2016). Bryman (2016:41) indicates that 'reliability is concerned with the question of whether the results of a study are repeatable', and 'it is fundamentally concerned with issues of consistency of measures' (Bryman, 2016: 156). Stability, Internal reliability and inter-rater reliability are three notable factors involved when considering whether a measure is reliable (Bryman, 2016). Reliability is especially at issue in connection with quantitative research. Validity refers to the believability or credibility of the research, and it is a measure of accuracy of a research and its results (Cohen et al. 2011; Bryman, 2016). The main types of validity that are typically distinguished internal validity (whether the study measures what it aimed to measure) and external validity (whether results can be generalised to a larger group or other contexts) (Cohen et al. 2011; Bryman, 2016).

According to (Mishler, 1990: 419), validation is the process of evaluating the 'trustworthiness' of reported observation, interpretation, and generalisations. There are four components for trustworthiness: 1) credibility (in preference to internal validity); 2) transferability (in

preference to external validity/generalisability); 3) dependability (in preference to reliability); 4) confirmability (in preference to objectivity) (Shenton, 2004:64; Bryman, 2016)

Credibility essentially asks the positivist researcher to clearly ensure whether their study measures what is actually intended (Shenton, 2004). There are some techniques can be used to establish the credibility, and in this study, the researcher focused on triangulation, thick description (see Section 3.3) and member checks. Triangulation strategy was adopted in this study to enhance the credibility of the findings (see Section 3.3). This SOLE study adopted both quantitative methods (questionnaires, examination results analysis) and qualitative methods (interviews, classroom observation and diary forms) to collect the data, and the researcher collected the data from different participants at the same time. Meanwhile, the qualitative data in this research emphasised the thick description (see Section 3.3) of a relatively small number of participants within the context of Xining, and the researcher could describe and interpret the phenomenon in detail for promoting credibility. In order to avoid bias and improve the accuracy of the data, the researcher always timely shared her notes with two teachers for ensuring her observation and interpretations seemed to be representative of their perspectives. Member check process gave the researcher a chance to verify her statements when participants were willing to fill in any gaps.

Transferability is the generalisation of the work findings at hand to other situations and contexts (Shenton, 2004), and it means 'similar projects employing the same methods but conducted in different environments could well be of great value' (Shenton, 2004:69). In this study, the researcher could not prove that the research findings must be applicable to other contexts and populations, but the researcher provided a sufficiently detailed description of the research contexts, research approach, and participants in this research, which would allow for the transferability to other settings. Samples could change, but generalisations to other participants and situations would be dependent on specific contexts.

Dependability is the extent that the research could be repeated by other researchers in the same context, with the same methods and with the same participants, and that the findings would be consistent (Shenton, 2004). The researcher provided enough information in the research report which included the research design and its implementation, the operational detail of data gathering, and assessment of this study. If other researchers wanted to replicate this study, they might obtain similar findings as this study did.

Confirmability is 'the qualitative investigator's comparable concern to objectivity' (Shenton, 2004: 72), it is about the degree of neutrality in the research findings. In this study, the researcher had tried to avoid potential bias or personal motivations via triangulation, and she spent sufficient time with participants to record their behaviour and also clarified tentative findings with participants timely, so the findings were based on participants' responses accurately and objectively.

3.9 Ethical Considerations

This SOLE research was given ethical approval by Newcastle University, and the researcher worked within ethical guidelines. Participants were recruited voluntarily and kept anonymous in this thesis. The contents of the questionnaires, diary forms and interviews notes were provided to the participants at any time, and they could withdraw anytime without giving a reason. All the collected data are kept securely and will not be shared with other researchers in their study without the agreement of the participants.

The SOLE group in this research was a class with 58 students (57 after Nov. 2014) under 18 years of age. After communicated with three school leaders, they confirmed that all teachers who participated in this SOLE research had enough expertise to protect children from psychological and emotional damage in the class. In addition, before this SOLE research began, the researcher provided all participants with the 'Consent Form' and 'Participant Information Sheet', to enable them to understand the proposed research contents fully.

Participants were told about the purpose of this research, where the research data would be stored, in what format, and for how long. The researcher also informed all participants that in case the child participant felt uncomfortable during the research, the researcher would suspend all studies and communicate with students and teachers in a timely manner, further to analyse the causes which made them uncomfortable, as well as to find the effective solutions.

The diary forms and questionnaires for participants were not sensitive in nature, and the researcher did not force or compel participants to respond to any questions. For research confidentiality, the researcher did not disclose their names or personal information in the research report.

This research was an academic student project, personal experiment project, and all collected data were saved in three ways. First, the researcher used portable storage devices (laptops, USB sticks, external hard drives) to back up electronic copies of all data, and updated with any changes when possible. Second, the researcher also considered the nature of the data and the risks involved, and used cloud storage services to back up a tiny piece of data, such as students' exam scores. Encryption was used to secure files and data information for above two ways. Third, the researcher put all paper documents in three locked drawers where they were kept away from fire and moisture. All data will be deleted after the researcher completes her PhD thesis.

3.10 Chapter Summary

This chapter introduced the research questions, research philosophy, research sampling, data collection methods, data collection and analysis procedures, reliability and validity, and ethical considerations. In the following two chapters, chapter 4 will show the analysis results of History lessons in the SOLEs, and Chapter 5 will intend to find out the similarity and dissimilarity that did the SOLE tasks with maths lessons.

Chapter 4. History Lessons in the SOLEs

4.1 Introduction

This chapter includes seven sections. Section 4.2 gives details of the course design and schedules of 20 History lessons. Section 4.3 describes how the SOLE class was conducted, and the different classroom reactions of the History teacher and students for both the SOLE group and non-SOLE group. The different roles the teacher played are also introduced in Section 4.3. Section 4.4 presents thoughts, opinions, and advice from the teacher, students, and parents. Section 4.5 sets out a detailed analysis of students' homework and exam results with two research groups. Finally, a detailed account of the SOLE classroom observations for the first lesson, the tenth lesson, and the twentieth lesson will be given in section 4.6.

4.2 Course Design and Learning Arrangements

Junior high schools should be run in accordance with the prescribed teaching curriculum of China's Ministry of Education, and Eighth-grade students have to acquire and master the important information about the history of modern China from 1840 to 1949 (first semester) and Chinese contemporary history since 1949 (second semester) presented in their textbook. The history teachers should develop students' ability to recognise historical photographs and analyse historical events which are introduced in their textbooks, guide students to summarise those complicated historical problems, and enhance students' national pride and patriotic feeling. The students are expected to memorise facts and interpret data after each class. After much discussion, the History Teacher A (anonymous) and the researcher conducted our SOLE observations as follows.

First Semester:

Date	Main Discussion Topic
19.09.2014	History of The Old Summer Palace (1709-1860)
26.09.2014	The First Opium War (1840-1842)
	The First Sino-Japanese War (1894-1895)
The National Day holiday period (01.10.2014—07.10.2014)	
10.10.2014	The Self-Strengthening Movement (1861 – 1895)
17.10.2014	The Hundred Days' Reform (1898)
24.10.2014	The Revolution of 1911 (1911-1912)
31.10.2014	The New Culture Movement (1915-1923)
Mid-term examination week (04.11.2014—07.11.2014)	
13.11.2014	The founding of the Chinese Communist Party (1921)
20.11.2014	The Northern Expedition (1926-1928)
28.11.2014	The Mukden Incident (1931-1932)
	The Nanking Massacre (1937-1938)
04.12.2014	The "Three Great Battles" (1948-1949)
	The Liaoshen/ Huaihai/ Pingjin Campaign
Final examination week and Winter Holiday	

Second Semester:

Date	Main Discussion Topic
06.03.2015	The Founding of the People's Republic of China (1949)
13.03.2015	Agrarian Reform (1947–1952)
27.03.2015	The First Five-Year Plan (1953—1957)
03.04.2015	The Four Cleanups Movement (1963-1966)
10.04.2015	The Great Proletarian Cultural Revolution (1966–1976)
17.04.2015	Chinese Economic Reform and Opening up (1978-1993)
24.04.2015	Transfer of sovereignty over Hong Kong and Macao (1997/1999)
Spring Sports (28.04.2015—30.04.2015)	
Mid-term examination week (06.05.2015—09.05.2015)	
15.05.2015	National Defense Construction and Diplomatic History (1950s-2001)
22.05.2015	The Basic Education Reform and Development ((1950s-2001)
29.05.2015	The Great Scientific and Technical Achievements (1950s-2001)

Table 4.1: Learning arrangements for history lessons

4.3 Classroom Observation

To ensure students in the SOLE group and the non-SOLE group were at an equivalent level in history before this experiment (September 2014), the researcher referred the examination results for July 2014. After discussion (see Section 3.4.2), we selected a class with 58 students (57 after Nov. 2014) as the SOLE group, and another class with 61 students as the control group (non-SOLE group). History Teacher A was assigned to these two classes, and it was helpful to be able to work with the same teacher to observe the behaviour and achievements of students in the SOLEs and the conventional lessons.

In the open meeting with all participants before this experiment, the researcher had presented details of the SOLE approach to Teacher A and all students, and the researcher was confident they understood how it works, so we started the lesson with a simple reminder. For the SOLE group, in every class Teacher A first took about 2 minutes to show a slide with 3-7 questions based on her lesson plans and course contents, and told her students what she expected them to complete before the class ended. Then, the students were encouraged to study in a group of 4-6 to find answers to the above questions via online resources, and this process took about 35-40 minutes. Mitra (2015) recommends that students should get into groups of four (approx) to one computer in a SOLE. However, class sizes in this junior high school were big that each class had around 60 students, considering the last step in a SOLE would invite the students to share their stories of collective discovery within fifteen minutes, Teacher A and the researcher were worried that there was not enough time for all groups did it, so the variation in group size for reducing the number of groups was necessary. The students could take notes or capture screenshots by QQ (a popular software in China), and they could share collected information and important notes with each other. As explained in Chapter 1 (section 1.2), normally children should be allowed to choose their own groups in a SOLE, but during the initial three courses, Teacher A chose the groups because she was worried she could not manage the noisy class effectively if students were self-selected with their friends.

However, when Teacher A and the students became more familiar with the SOLEs, students were allowed to self-organise into their groups, and they could change their group as they wish during a lesson. Finally, in the last 10 minutes, Teacher A would invite some students to share their answers, evaluate the performance of each group, and make a summary together with students of what had been learnt in the lesson.

As a classroom observer, the researcher did not intervene in their work, unless students put up their hands to ask for help, and intervention was rare in History classes (field-note). The researcher walked around the classroom and made notes from time to time. The researcher prepared a form (Appendix H) to record some key information in the class, such as recording students' motivation and enthusiasm to learn and discuss, the time students required to carry out a task, the respective roles of Teacher A and her students, and the whole learning progress. Occasionally, the researcher did not have enough time to record important findings in class, so she recorded the observations using a recording device when her memory was still fresh, and after class she added these additional remarks to the observation notes taken during class. This is the typical procedure that was followed for the SOLE lessons in this study.

For the non-SOLE group, there was no change to the normal lesson procedure, as described below. As a participant observer in the non-SOLE group, the researcher just sat at the back of the classroom and kept silent while the classes went on, without any intervention. As mentioned in Section 2.4, curriculum guides and materials used in China's education systems are required to bear an approval from a national or system-level authority, teacher's version of textbooks in China provide instructional suggestions for teaching each lesson, and teachers are required to cover the content that is specified in syllabus and textbooks, no flexibility in deciding what is taught and learned. Thus, Teacher A used the same syllabus and course contents as the SOLE class. She asked students to read the textbook aloud first, then, she summarised all the basic points the students were expected to learn during the lesson on the blackboard. In the SOLE class, students might find additional relevant historical knowledge

which was not included in the textbooks by themselves via online resources, and these contents could help them better understand the interrelated historical topics, and further help them achieve excellent marks in the examination. Teacher A also provided the students with some extra information, which was likely to be more limited than that which could be found online. Teacher A also suggested students take notes on important points, and before the class ended, she always took around 10 minutes to pose some relevant questions about the lesson to check whether the students had mastered what had been taught. However, unlike the SOLE class, students in the non-SOLE group were asked to think and answer questions independently, rather than work in a group.

4.3.1 *SOLE Group Students' Reactions*

The researcher observed students' learning initiative (actively or in silence), learning process (searching and finding), and learning outcomes (summarising and presenting) in the class, and the researcher found most of the students were willing to study history lessons in the SOLEs. They thought it was essential to have a lively class atmosphere in teaching and learning, which made them feel happy and not bored. The students were excited to discuss and solve history problems using resources they found on the topic on the Internet, and they were euphoric if they could find interesting reading material or videos faster than anyone else. Students were hungry for Teacher A's praise and classmates' envy, and they would be in a cheerful mood during the whole class if they were praised. Students' answers on their diary form further verified these conclusions, and the researcher will discuss this part in Section 4.4.

The results of the classroom observation showed that there were significant differences in behaviour among the students, however. Some students actively participated in group discussions, dialogue and created impressive presentation on behalf of his/her group. However, there was also a small group of students who were timid and hardly participated in discussions, and according to their diary feedback, the researcher learned that these students almost never spoke up because they were afraid that classmates would judge them for saying

something stupid. Teacher A made an effort to encourage these timid students to speak up at least once in every group discussion, and she also hinted that other group members should not crowd them out. We found that this situation improved after students organised themselves into groups with their friends, but the problem could not be completely avoided.

In the first five classes, some negative reactions were recorded. For example, some students did not do the task they were asked to do, and the researcher noted that certain students repeatedly browsed the web for entertainment news and celebrity gossip during the discussions, or they played web games covertly. Teacher A got angry about it and this was one reason why she preferred to group the students by herself and designated a group leader to monitor group members' behaviours. The teacher talked to these students to persuade them to change their attitude, and they explained that they were banned from using the computer at home, and they wanted to seize the chance to browse some websites they were interested in. They knew they were doing something wrong in class, and under the guidance of Teacher A and the researcher, these students did appear to stop accessing material unrelated to the class. Furthermore, this situation also improved after they were familiar with learning in the SOLEs, because most of them began to enjoy working with it.

On the other hand, the researcher and Teacher A found that in the first several classes, students did not know how to search for useful information via the correct keywords. Most of the time, students directly typed the whole question into the search bar and wrote down all the information they found online. However, after about six lessons, some of the students could use critical thinking skills to construct their knowledge in the SOLEs. For example, when they read those questions posted by the teacher, they did not rush to type the whole question into the search bar in the first place, but they discussed with their group members which keywords should be used to find out answers. Then, these students did not write down answers immediately, they analysed and selected one of the most useful sections as their answers and then wrote it down. Teacher A also created a supportive environment in encouraging students

to use their critical thinking ability. For example, occasionally, in the last ten minutes, when students share their answers, they might hear two different answers for one question from different groups, when this happened Teacher B always encouraged students to give reasons for their opinions without fear of getting the wrong answer. It seems likely that learning in the SOLE could guide students to become an independent and critical thinker.

4.3.2 *Non-SOLE Group Students' Reactions*

Classroom observation of the non-SOLE group showed that the large classes in this school limited teachers' and students' interaction, and Teacher A told the researcher that this situation is also a general problem in China. In the conventional teaching mode, it is difficult to actualise the student-oriented teaching theory due to a lack of learning atmosphere. Those students in the non-SOLE group could only acquire information that Teacher A taught based on the textbook in the class, and they could only understand limited questions that Teacher A listed. As a result, in the class, students were in a passive learning position, and they did not have any chance to acquire more additional content online as the SOLE group did. Students in the non-SOLE class only had access to information about historical events via textbook content, via the teacher's language, and via the summarised information which was written on the blackboard. When they answered those questions posed by Teacher A, they only needed to find and read the relevant the paragraph or sentence from the textbook, without any innovative thought. Sometimes students were unwilling to put up their hands to respond to Teacher A, and she had to select 2-3 excellent students in the class to answer her questions. Compared with the classroom observation in the SOLE class, student's engagement in the non-SOLE class was uncertain. The students in the SOLE class who were active learners were more engaged and excited to learn, and they had more fun in the process of learning.

4.3.3 *Teachers' Role in the SOLEs*

As was pointed out in the methodology chapter, all classes had to be conducted in accordance with the teaching programme of China's Ministry of Education, and the day before the SOLE

class, Teacher A and the researcher had to take notes and design the questions in the light of the following:

(1) Teaching objectives; (2) Teaching contents; (3) Teaching key points;

(4) Teaching difficult points; (5) Teaching methods; (6) Teaching evaluation;

Teacher A told the researcher what history knowledge needed to be grasped by students in this lesson, what questions needed to be answered, and if students could not solve all problems, they should meet the minimum requirements (i.e. answer the core questions). Teacher A and the researcher also tried to search for relevant network information based on those questions when preparing the class, and speculated about what resources might be found and discussed by students. These preparations supported us in our observation and analysis of students' activities in the SOLEs. For example, if Teacher A posed the question 'What happened in the Chinese Civil War?', and we entered that exact question in the search box (most students tended to do this), maybe we could not get a clear answer, but if we added some keywords to the question, such as 'Chinese Civil War date, location, result', we could quickly gather the information we needed. In the SOLE class, the researcher walked around the classroom to observe how much time the students spent on one question, what keywords they used, and so on. There were not many tools to help the researcher record all of the above information from each group accurately. The researcher could saw what they were doing through their laptop screens, and the researcher could capture the above information from small group's conversations.

During the SOLE class, Teacher A posed the questions (Appendix C) to students first and then became a friendly spectator or mediator to encourage students to solve problems by themselves within the SOLEs. As she was working in a SOLE, Teacher A did not need to summarise the key information on the blackboard, she did not need to help students to understand all the textbook contents paragraph by paragraph, and she did not need to narrate new stories to help students understand the historical events clearly. For most of the time, she

only walked around in the classroom to observe students' activities to make sure no students accessed unrelated matter online, and most of the time she stood somewhere quietly observing the class. In rare cases, some students put up their hands to ask for help, and Teacher A would guide them to do something according to the circumstances. Teacher A and the researcher also kept communication during the SOLE class to discuss if an intervention was required for students. The traditional teacher's role is minimal with the SOLE group.

At the beginning of this experiment, Teacher A was not accustomed to being a spectator in the class, although she understood what she should or should not do in a SOLE, she always wanted to interrupt the discussion and voice her own opinion on a historical event. For example, when she found students used an irrelevant keyword to search for answers, she could not help correcting students and giving them an exact keyword. The researcher also noticed that Teacher A was genuinely interested in hearing the students' answers in the early discussion stage, and if she thought the answers were incorrect or incomplete or not pithy, she would give her own answers to the group, and ask them to move on to the next questions. After the class the researcher guided Teacher A more towards using SOLE and then incorporated this method into her lesson plans, and gradually she started to keep silent and only walk around the classroom observing students' work unless students asked for help.

Date	Intervention times	Date	Intervention times
19.09.2014	> 9 X(teacher)+2(researcher)	06.03.2015	1
26.09.2014	5	13.03.2015	1
10.10.2014	3	27.03.2015	0
17.10.2014	3(teacher)+1(researcher)	03.04.2015	0
24.10.2014	2	10.04.2015	0
31.10.2014	0	17.04.2015	2
13.11.2014	0	24.04.2015	0
20.11.2014	1	15.05.2015	0
28.11.2014	0	22.05.2015	0
04.12.2014	2	29.05.2015	0

Table 4.2: The number of times that mediators intervened in discussions in history classes

According to the field notes, the researcher gave a count of how many times the mediators intervened in discussions in each SOLE class (Table 4.2). The researcher only provided assistance in two classes. In the first SOLE class, Teacher A intervened in discussions at least seven times, but when the researcher offered her help as students needed, she was not paying attention to the teacher, so the notes were incomplete. It could be seen that students gradually no longer needed intervention from the mediators, and Teacher A also gradually adapted to her new roles in a SOLE and did not intervene in discussions if students did not need her help.

Teacher A built the scaffolding for learners, and as a mentor or a facilitator, Teacher A had to give some comments and summary for the students' discussion, and post further explanations for those questions that hadn't been answered completely. She had the consciousness to accept her new role to act as a spectator or mediator of the new pattern of knowledge, but also as an excellent mentor and facilitator to convey knowledge to the students.

4.3.4 *Teacher's Role in the Conventional Teaching*

Teacher A used the same lesson plans in the non-SOLE group, but the teaching and learning procedures were predominantly teacher-centred and book-centred. The questions were not all posed at once at the beginning of the class like in the SOLE group, and Teacher A only asked and answered one question at a time. Teacher A and her students were working and exploring the historical facts together, and she focused on guiding students to take notes with correct answers for questions, so relative to the SOLE class she did not provide opportunities for the students to develop their ability to explore and create their own understanding. It is hard to guide each student individually to get involved in the personal touch due to the large class, and compared with the SOLE group, Teacher A's role was that of an administrator of designing teaching contents and controlling discourse of the classroom, and she was also a leader in teaching and transferring knowledge in the non-SOLE group.

4.4 Diary Feedback Analysis

After each SOLE class, the researcher provided a diary form to each participant (i.e. both Teacher A and the students), and the researcher invited them to answer some questions about their experiences in the SOLEs of the day. Usually, the feedback would be collected by the next morning, and if the SOLE classes were conducted on a Friday, the feedback would be collected on the following Monday morning. A further discussion about the diary form feedback follows, and detailed copies can be found in Appendices E and F. Section 4.4.1 will provide a detailed analysis of students' feedback, and the analysis of Teacher A's self-reflection will be stated in Section 4.4.2.

4.4.1 *Students' Feedback*

The diary form (Appendix E) included some fixed questions, such as:
- What is the most rewarding part for you in this lesson?
- What is the most challenging and easiest thing in this lesson?
- How many students were in your group? Did you change groups? What did you do? How well did your group members do?
- Did you find out the answers to all the questions? If not, would you please explain briefly why not?
- How much of the content have you mastered?
- What will you do differently next time?

And, students could add any problem on the form depending on the learning contents of the day.

To encourage students to provide honest responses, before writing the first diary, they were told that the diary feedback could be provided anonymously, but there were still seven students who left their names and WeChat accounts (China's most popular messaging App) on the diary form in order to get a response from the researcher. Then, from the second SOLE class, all students were allowed to mark their name on the form if they would like to further

communicate with the researcher and Teacher A. In total the researcher conducted twenty SOLE classes, and collected diary form feedback twenty times. Table 4.3 shows a high submission rate but there were always some who failed to submit (these figures did not include feedback gathered in face-to-face interviews). When the researcher collected the feedback form, she could know which students did not submit it, so she tried to ask them why they did not complete it (not blaming communication), and most of them said they did not record their experience just because they forgot to do it, or they were too lazy to do it, or they lost their Forms. According to what the researcher had learnt, students in this school had no experience with submitting any type of diary feedback, so it was difficult to conclude that this was indicative of reactions to the SOLEs, or to learning in general for those students. The researcher invited these students if they did not mind talking with me face-to-face, she could spend a short time during their break to listen to their feedback, and she also used this semi-structured interview technique to record their answers.

Lesson	1	2	3	4	5	6	7	8	9	10
Sent	58	49	58	58	56	58	54	57	56	57
Returned	52	39	50	49	49	50	46	53	55	52
Lesson	11	12	13	14	15	16	17	18	19	20
Sent	56	57	57	57	53	57	57	56	57	57
Returned	50	48	48	51	44	51	52	49	56	57

Table 4.3: Response rate statistics for students' diary form feedback in history lessons

Most students could provide a detailed description of their experience, some of them recorded the same comments, and most comments repeated many times after different lessons. According to Table 4.3, the researcher received 1001 diary forms in twenty classes, and students needed to answer 10 specific questions for each diary form, so the researcher filtered the information from 10010 answers. The researcher categorised their answers by positive, negative, neutral responses and others. In total, there were 4062 positive responses, 893 negative responses, and 1097 neutral responses. Here are some typical extracts from their feedback:

[Positive]

"This is not only a fun way to learn, but it is also very effective." (19.09.2014, Student-7)

"I think I did a good job!!! Teacher A praised our group, and I have never been praised before. I look forward to the next SOLE class. I love to be praised." (10.10.2014, Student-26)

"Today I self-organised group with my best friends, we have the tacit understanding, and we are the first group answered all questions." (13.11.2014, Student-14)

"I am increasingly familiar with the SOLE learning, I like to push aside my textbook and read interesting historical stories online with my classmates together." (13.11.2014, Student-42)

"Today I had words with someone because I did not let him touch the laptop when I was searching for information. He did not stay with our group, and I know I was wrong. I will examine my mistake." (06.03.2015, Student-22)

"In this lesson, our group only spent 24 minutes to solve all problems and teacher A also agreed with our answers, so excited!" (27.03.2015, Student-30)

"Learning in the SOLEs is a good experience. It broadens my mind and helps me establish a new point of view on thinking, and I like to discuss problems through the group cooperation, I am continuously learning from others' advantages." (29.05.2015, Student-36)

"Videos and images about historical events could help me remember relevant knowledge points. I could recall almost every detail when I do the exercises, and it is an effective learning method to avoid falling into rote learning habits." (29.05.2015, Student-45)

[Neutral]

"I noticed that the answer to the second question only has 61 Chinese characters in the textbook, but there are more than 300 Chinese characters to explain it by online information. An increase of extra-textbook knowledge is a good thing, but I am lazy to remember all contents from websites." (10.10.2014, Student-11)

"Teacher A said we should use some keywords to find out relevant resources. I did not know what the keywords were, but my group members could understand it." (17.10.2014, Student-23)

"Two of my group members did not speak up during the discussion, but they found out some useful information for us." (20.11.2014, Student-11)

[Negative]

"I do not like this learning method because I am not good at operating the laptop." (26.09.2014, Student-30)

"Today we did not complete the task because we thought the questions were quite difficult to understand. We did not have enough time to summarise the historical significance of the Revolution of 1911, and I still feel confused about the relationship between Yuan Shikai and Sun Yat-Sen." (24.10.2014, Student-7)

"Not enough time to answer all questions because we selected the wrong keywords. We will carefully analyse questions next time." (13.03.2015, Student-35)

As mentioned above, the researcher collected a total of 1001 diary forms from students in twenty SOLE classes, and she read all sentences they wrote about their experiences in the SOLEs. It is impossible to quote everyone's answers here, but the following words were repeated most often in their feedback forms: Collaboration (366 times), Attractive (283 times), Interesting (195 times), Innovation (153 times), Interactive (87 times), Ability of

generalisation (69 times), Self-motivated (62 times), Widen the horizon (49 times), Lengthy online resources (41 times). At first they were not accustomed to this new learning style, but over time, most students thought that learning in the SOLEs was a good way to acquire more historical knowledge which could not be found in their textbook. They enjoyed the progress of solving problems in a group, and they also admitted that the online resource was a powerful tool to support their learning. The comments changed as the study progresses.

4.4.2 *Teachers' Reflective Diary*

Teacher A also recorded and observed students' class performance via her diary form. She said the diary form was also a useful tool to help her reflect on and evaluate her teaching, and she also used these detailed records to help her gradually adapt to the SOLE learning style. Sometimes the researcher could get Teacher A's immediate reflections about the lesson through audio-recorded chat after the lesson or when she was free while the students were doing the SOLE, but Teacher A preferred to write them down and keep them by herself for later review.

According to Shandomo (2010:103) 'reflection is a process of self-examination and self-evaluation in which effective educators regularly engage to improve their professional practices', and reflection on teaching could help teachers to grow toward greater effectiveness (Shandomo, 2010). The SOLE learning method brought a new classroom experience for Teacher A, Teacher A thought that no matter how good a SOLE lesson was, the teaching strategies and methods could always be improved.

The diary form was a useful tool to help the teacher reflect on and evaluate her teaching and classroom activities, and it also helped the teacher record and analyse everything that happened in the lesson. Using this information we could make improvements in teaching strategies where necessary.

The researcher got Teacher A's self-reflection notes via her diary forms, and occasionally via audio-recorded chat. The diary form consisted of the following questions:

[Students]

· Are you satisfied with the students' classroom performance in this lesson?

· What do you hope students should gain and master in this lesson? Did the students understand all of that?

· Did the students finish the lesson contents as your planned? Why or why not?

· What were the hardest problems to answer in this lesson? Did they finish the expected tasks?

· Did all students participate in the SOLE lesson?

[Lesson Objectives]

· How about the task completion rate toward your teaching goals?

· What do you think of those questions you designed? Did these questions keep the students engaged in the lesson?

· Were these questions too easy or too difficult for the students?

· Is there anything that needs improvement next time?

[Classroom Management]

· Did you intervene too much in this SOLE lesson?

· Did you create an atmosphere of friendly communication and collaboration for students?

· Was this lesson completed at a reasonable pace?

[Teacher]

· Did you respect students' dynamic participation in the SOLE?

· How did you deal with the problems that came up during this SOLE lesson?

· Were you perceptive and sensitive to each of the students' needs?

· Did you allow the students to discover themselves without being embarrassed of lacking knowledge?

· How was your attitude throughout class?

· How can you do it better next time?

Teacher A completed all her twenty diary forms in the SOLE classes (Appendix F). Teacher A needed to answer 18 specific questions and was allowed to add notes for each diary form, so the researcher filtered the information from 380 answers. As students' feedback, teacher A's responses were also categorised by positive, negative, neutral responses and others. In total, there were 142 positive responses, 85 negative responses, 65 neutral responses. Here are some typical extracts from their feedback:

The following is a typical extract from Teacher A's reflections:

[**Positive**]

"Obviously, the web-based learning itself has many advantages to promote the development of self-organised ability, and it is not only a challenge to the conventional learning method but an entirely new learning model that meets the need of the secondary education in the network days." (26.09.2014)

"I posted a difficult question about Sino-Japanese War, which exceeded educational syllabus and above their level, and I wanted to know if they could solve the similar problems via online resources. They did better than I expected, the group cooperation helped them pool their wisdom together. Based on my experience, I am almost sure students in the traditional class will not answer this question in-depth. Learning under the network environment is good for creativity and independent learning ability of students." (26.09.2014)

"Network environment provides an advantage for students' self-organised in History, and to develop students' cooperative study ability in the SOLEs is a necessity in the present development of educational reform." (04.12.2014)

"I talked to the students today, and they felt it was no longer interesting to have a history lesson in the conventional model, whereas the SOLE method of teaching makes it possible to have pedagogical innovation." (03.04.2015)

"Through network-based learning in the SOLEs, students' learning initiative had been promoted. In the conventional classroom teaching, it was a common phenomenon that teachers raised questions while students answered them, which was regarded as the only mode of classroom questioning. This is a limitation to foster student's capability of practice." (29.05.2015)

[Neutral]

"Today I allowed students to self-organise into their groups. I found that boys and girls were almost separated into different groups, so I guess students prefer to select their friends as the group member. This situation made me think of another problem, should boys and girls be in separate groups? I am not sure the answer… Some of them changed their groups during the class, but I did not know the reason." (10.10.2014)

[Negative]

"I am not familiar with control the classroom instructions in a networked environment, and learning in the SOLEs is also entirely new to my students. All the students were very excited today, and I worried they could not completely devote themselves to study due to hyperactivity. Most students did well in this lesson, but some students used the laptop for a reason not related to a SOLE task, I did not think it is good." (19.09.2014)

"I noticed that some students still did not know how to select the keywords from a question to find out relevant information online. For example, in this lesson one of the questions was—[What can you learn from the Taiping Heavenly Kingdom Movement, Hundred Days' Reform, and Boxer Rebellion?]. This is a comprehensive analysis question, and a similar one was tested in the entrance examination for the secondary school in the previous year. Students should first analyze the causes, full course and final results of these three movements, then further explain the reasons for the failure, and finally summarise the assessment on it. In the

SOLE class, those excellent students use Movement + time, Movement + causes/ course/ results/, Movement + aftermath, and so on, as the keywords to search for relevant online information. However, some students entered the whole question word for word in the search box and tried to find the answer directly. I suggested them to change groups and looking at other's work.'' (17.10.2014)

4.4.3 *Parents or guardians' Comments*

In Section 3.4.3, the researcher explained the importance of parents and guardians for this research. Before the experiment, the researcher held a joint meeting with two teachers who would be engaged in the SOLE research, 58 students, and their parents. 54 parents attended this meeting, and 4 parents gave the researcher a call saying they could not take part in the meeting because it clashed with their work. The researcher explained details of the SOLE experiment, and handed out a short paper questionnaire to them during the meeting, with five closed and two open questions about their attitudes toward their child's online behaviour and the SOLE experiment (Appendix A).

In this meeting, most parents expressed a strong interest in the SOLEs, and they were willing to accept this new method of studying to cultivate children's interest in learning. However, 7 parents expressed their doubts about SOLE learning. They worried that if minors use the network in an unreasonable way such as indulging in net chatting or online games, and fail to resist the draw of the Internet, it would affect their learning and lead to poor academic performances. The researcher explained again that the SOLEs would be conducted within a group, the cooperative learning could support students supervising each other, and it was difficult for students to use the network in an unreasonable way individually. Meanwhile, the teacher and the researcher would be in the classroom to observe students' activities, and we could prevent students from doing inappropriate actions online in time. In addition, the researcher found parents tended to trust the teachers, so she also invited the history Teacher A and math Teacher B to substantiate her statements again. Based on our advice and patient

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explanation, these 7 parents finally agreed to let us conduct the SOLE experiment in this class.

The researcher recommended the parents to communicate with their children after each SOLE lesson if they would like, and tried to stay focused on what their children learned in the history and math lessons. Parents' comments about the SOLE experiment would be collected again at the end of the research.

(1) Parents or guardians' responses before the SOLE experiment

A total of 54 questionnaires were collected from 54 parents, 52 were available (two parents wrote on the paper that they were too busy to stay with their children, so they could not give answers of question 1and 2), detailed results as follow:
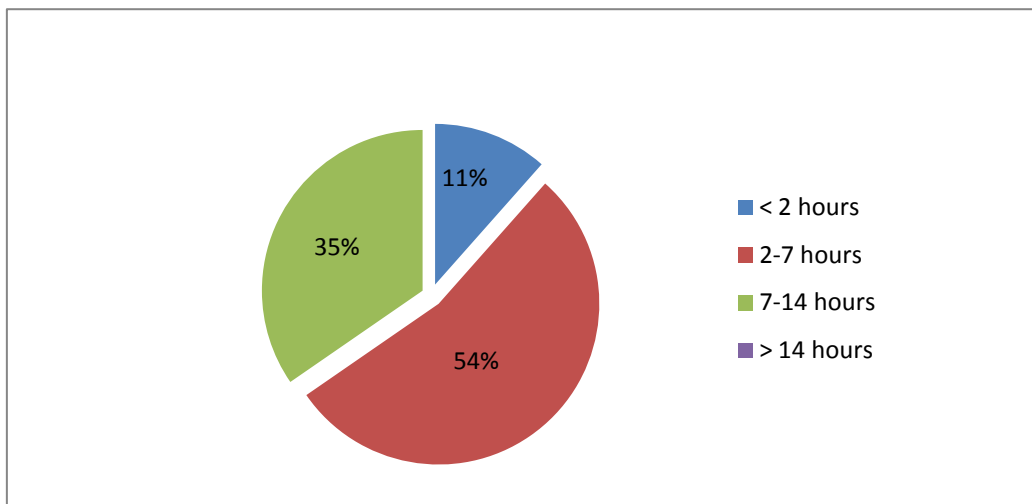
Figure 4.1: How long is your child allowed to surf the internet every week?

Chinese students have to spend much time on homework for different subjects every night, and this is why most of the parents do not allow their children to go online except weekends. It is clear that more than half the students have to limit their online time to no more than 7 hours every week, and the researcher believes this was also the main reason why some students did not search for learning materials related to the topic they were supposed to be researching, but played web games and browsed entertainment news furtively during the first

three SOLE experiments. However, this question only provided information about what the parents were able to observe. The researcher did not know if any of the students had their own smartphones or tablets which they could use to surf the internet without their parents knowing, though some students told the researcher that their parents always took away their smartphones to control their online time.
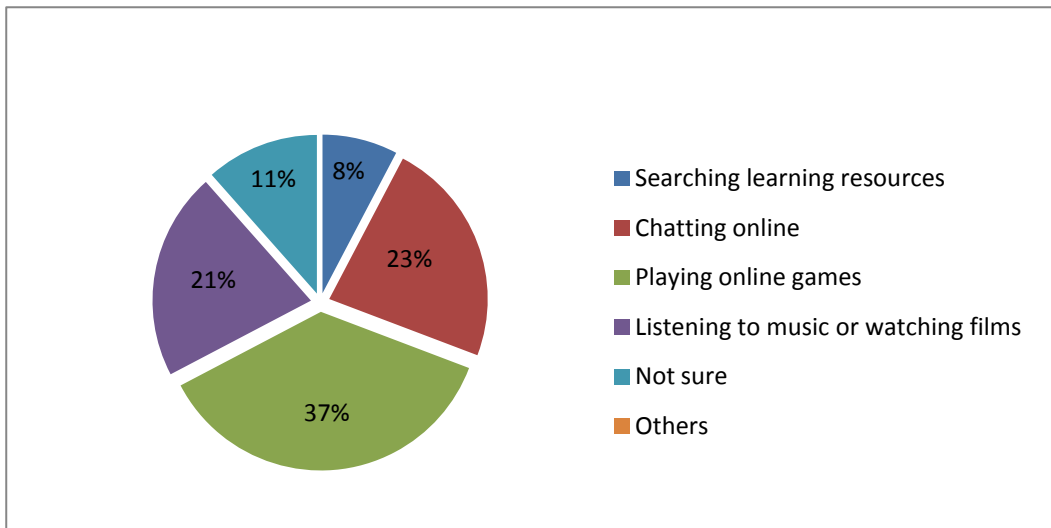
Figure 4.2: What does your child do online frequently?

There were 63 percent of parents indicates that their children spent lots of time on the Internet. In parents' eyes, the computer for most children is just for entertainment, such as playing online games, chatting, listening to music, and watching movies. This situation either directly or indirectly influenced parents' attitudes to self-organised learning environments using the Internet.
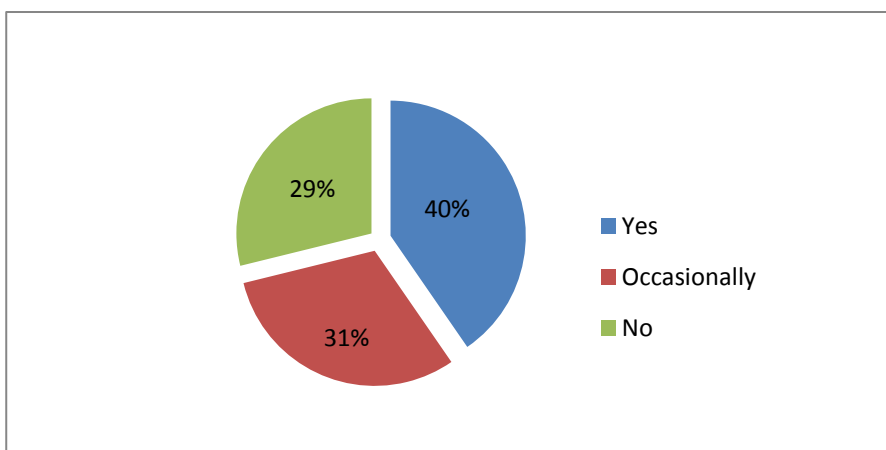
Figure 4.3: Do you monitor your child's Internet activity?

As can be seen from the pie chart, nearly 70 percent of parents admitted that they had the experience of monitoring children's online behaviour. With this closed question, the researcher also advised parents to write down the reasons for this, and two attitudes stood in sharp contrast. Some representative answers as follows:

[Have to monitor]

"I know the benefits of the Internet far outweigh the potential risks, but I must realise the potential dangers my child may face online."

"I want to know what his favourite sites are, what apps he likes using, and what he usually does online. I am afraid that he logs onto the websites with insalubrious content, and sometimes I checked the history of the Web pages he visited. I could get a sense of security via monitoring his online activities."

*"It is necessary for me to know whom my daughter chat with most regularly, and what the content of their conversation is. She once said that I did not respect her privacy when she was surfing the Internet, and shouted at me, I was very sad, but I think I am right."*

"I read some social news and I know the network is full of violence and pornography crime information, I think an effective Internet control will ensure my child is protected. I permit my daughter to use the computer in my room or the living room every Saturday and Sunday, and I can restrict her internet use."

According to the responses, 30 parents were very keen to supervise children's online activities and 7 parents monitored their children occasionally. These parents did not trust the sites and content their children would be able to access. This situation also explained why parents feared that self-organised learning environments with unsupervised access to the Internet

would affect children's learning outcomes.

[No need to monitor]

"I have to trust my child, and I believe he has the sense of proprietary to decide what to do and what not to do. The network is not that horrible."

"I never monitored my son directly. I often asked my son some questions tactfully about his experience online, and I could presume what he did indirectly. To some extent, The Internet makes it possible for my child to learn more about the world, this is a good thing."

"I am a programmer, and I introduced the Internet to my son when he was five years old. I told him the potential dangers early, although topics such as pornographic information tend to make us feel uneasy, it is imperative to teach him to protect himself online. I told him he could chat with people they know, he could not give out the information about our family members online, he could not meet online friends in person without an accompanying by his mother or me, and so on. We have rules, and he knows what he should do or not. On the other hand, two years ago, I told my son Online education was a new trend that could improve his ability to learn at his pace, at all times and places, and at present he always practices his English online, I highly encourage him to do this. Just now you give us a detailed explanation of the SOLE experiment, maybe some of the parents do not like it, but it is interesting for me, and I will advise my child cooperate with teachers and you to complete it."

There were 15 parents who thought they did not need to monitor children's online activities, because they believed that their children had self-discipline and the ability to distinguish right from wrong network resources, and some even believed that children could expand their knowledge by using abundant network resource fully and reasonably. This idea coincides with the main feature of SOLEs.
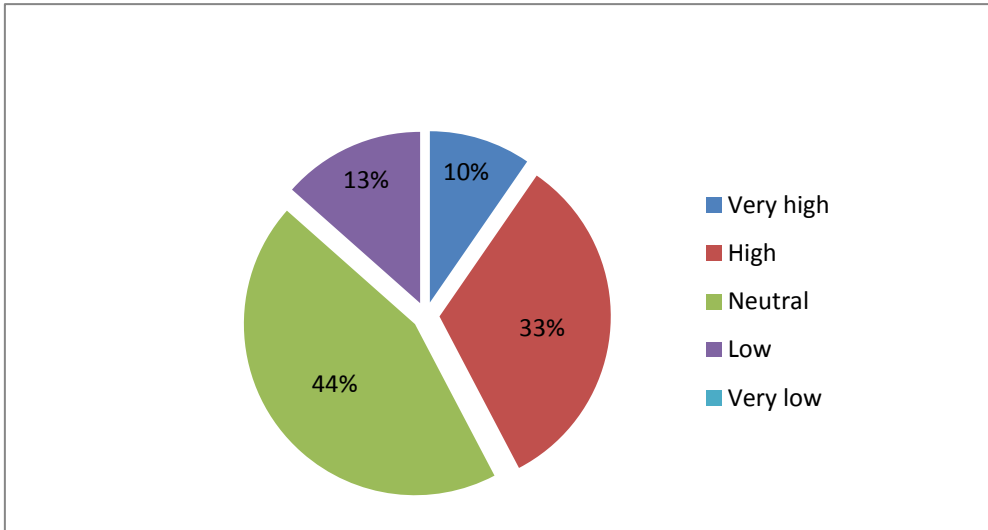
Figure 4.4: Are you willing to support your child in learning with SOLEs?

A small percentage (13%) of parents was not supportive of this experiment. As the researcher discussed in the third paragraphs of this Section 4.4.3, those parents who were unsure about the experiment finally agreed to let us conduct the SOLE experiment in this class after the teachers and the researcher provided them with a further patient explanation and persuasion.
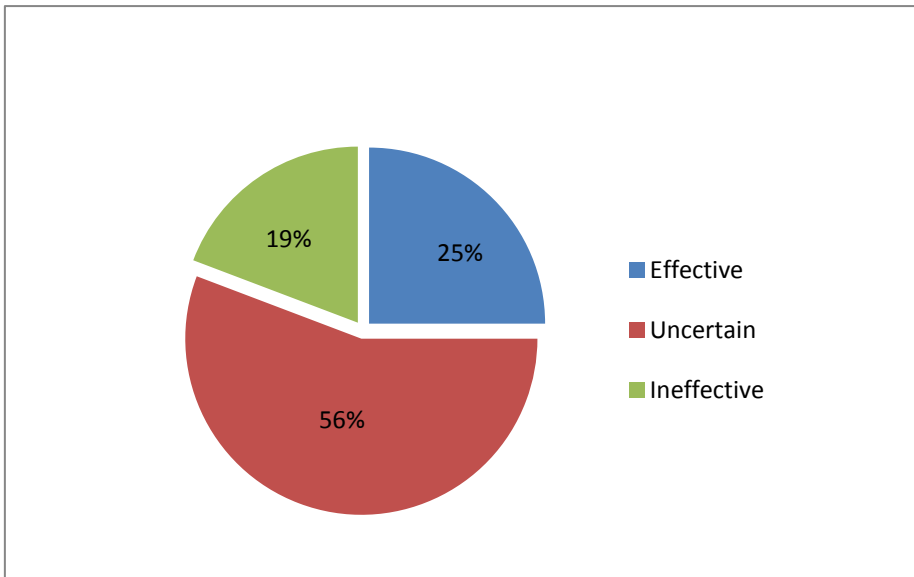
Figure 4.5: Do you think the SOLE method will be an efficient learning model for learners who are in the eighth grade?

Although the researcher explained in detail how a SOLE would be conducted and what students would do in the SOLE class, it is no surprise that 56 percent of parents have no idea about the learning effectiveness of a SOLE. This question will be posed again after we finish the whole experiment.

In addition to the above five closed questions, history Teacher A, math Teacher B, and the researcher also designed two open questions to better understand parents' views on the SOLEs. The following are typical answers:

Q6. What is the problem that most concerns you about Self-organised Learning?

"According to your research plan, you will occupy around six months within two semesters doing this experiment, students' previous learning styles will be completely changed, so, what should we do if the SOLE experiment influence children's academic performance?"

"Are you sure both History teacher and Math teacher can effectively keep discipline in her classroom? I think harmonious classroom environment can improve the quality of learning, and if asked students to self-organise into their own groups, will they be playmates or co-learner?"

"I hope it can help my child improve his test scores in the future examination."

"Can you use some filter software to monitor the websites which children surf?"

"How to avoid students switching off their minds and can focus their attention on the discussion?"

"How do you ensure that every single student gets involved in cooperative learning?"

Q7. What do you think about Self-organised Learning? What are the advantages and disadvantages?

"It sounds like a good learning method, and I believe if students use the technology and resources of network reasonably, The Internet will become the right hand on children's studies."

"The SOLEs method just caters to the speed developing of network and education system reform. According to your introduction, it sounds like the SOLEs can stimulate students' interest in the study, improve the learning enthusiasm and consciousness, and increase the learning efficiency and quality. However, we have to wait and see the actual research results in the future."

"The thing I care about at this point is my child's grades. To indulge in the network will influence students' learning achievement, but students have to use the Internet in the SOLE experiment, I hope the result is good for my child."

"I preferred to let my child study independently rather than in a group. I am very worried that he will attach himself to his group member for assistance, and stop thinking problems independently, and after all, he has to take an examination by himself."

According to their responses, the researcher was reassured that they had understood how the SOLE experiments would work in the next eight months, and the researcher also noticed their main concern--whether the SOLEs experiment would affect students' academic achievement. In fact, history Teacher A, math Teacher B and the researcher also wanted to know that whether the learning outcomes of the SOLE group would be better or worse than those for the non-SOLE group. The test results will be discussed in Section 4.5.2.

(2) Parents' or guardians' responses at the end of the SOLE experiment

On the last day of the SOLE experiment, a simple questionnaire with three questions was sent home with the student for their parents to fill in. The researcher sent out 57 questionnaires and received all 57 valid questionnaires. The results were as follows:
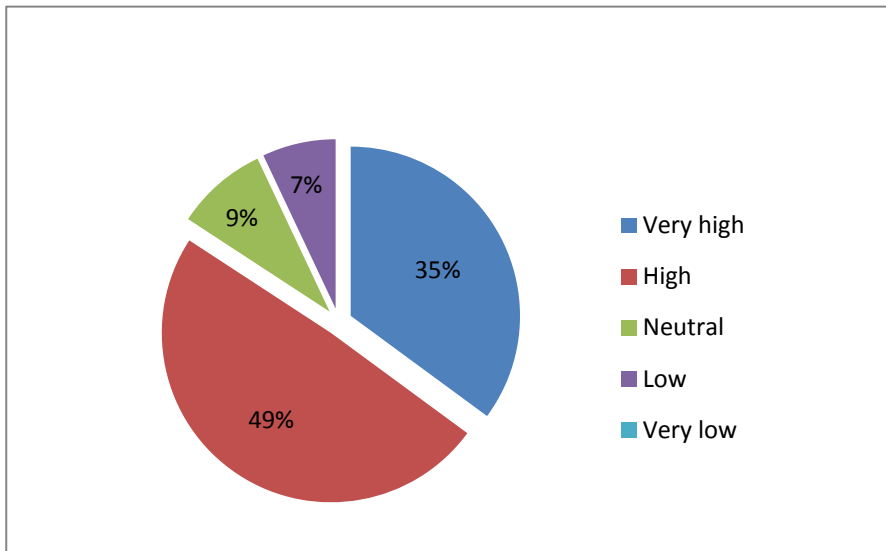
Figure 4.6: Are you willing to encourage your child keep using the SOLE method for history lesson?

According to Figure 4.4, only 43% of parents were willing to support children to try the SOLE method before we started this experiment. As is indicated in Figure 4.6, after 20 History lessons with the SOLE, although 7% of them do not think the SOLE method is a good way to learn Historical knowledge, 84% of parents agree that their children could continue having History lessons with the SOLE method.
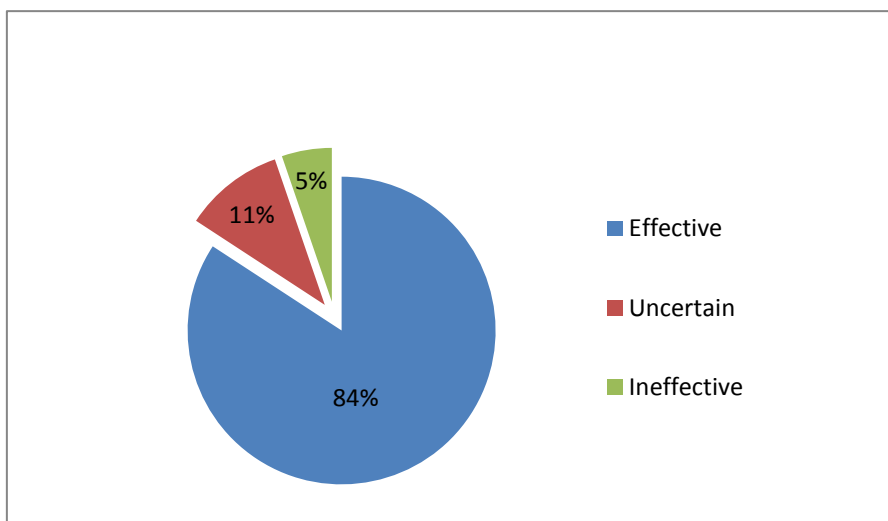
Figure 4.7: Do you think the SOLE method is an efficient learning method for history lesson?

Figure 4.5 shows that before the experiment more than 50 percent of parents had no idea about the learning effectiveness of a SOLE. Most of the parents maintained a good communication with Teacher A during the experiments, and by talking to Teacher A and their children, and following their children's academic performance during the period of the study, after 20 History lesson with the SOLE, 84 percent of parents think the SOLE method is an efficient learning method for History lessons.

The researcher also invited parents to answer one open question, i.e. "How do you evaluate Self-organised Learning Environments in the history class?" The following are some of the more interesting answers:

[Positive]

"This is far beyond my expectation of. My child really enjoyed the process of searching for answers online with his group, and he had proved that he could improve his test scores after using a suitable learning method."

"I believe the SOLE method provides more inspiration and motivation to my daughter, and it also expands her view and brings more open mind. Most of all, her History results also has a certain degree of progress, for us, this is a great satisfaction."

"One night at dinner, my son told me teacher A praised his group because they completed the learning task with flying colours, and he launched out into a colourful description of his experience in the lesson. He asked me a question about 'The Revolution of 1911', I did not know the answer, and he explained this issue to me in enough detail, I was surprised. Since that day, after each SOLE lesson, he would share with me relevant historical knowledge he acquired on that day. We had never done anything like that before. He got a high score in the midterm exam, and it is an excellent method to improve his learning interests and efficiency."

"Before this experiment, I always limited my daughter to access the Internet, and I thought Web surfing would distract children. Now I think spending some time on the Internet is not a bad thing for my child, and we can make it seem like a balanced learning style."

[Negative]

"There was no significant change in her exam scores. She said she did not like learning with anyone together in a group, and she preferred to learn in the traditional way. If the SOLE method is not suitable for my daughter, then I have to say I cannot give any positive evaluation about it."

In total, there were 52 parents expressed a positive attitude and 5 parents gave a negative attitude on using the SOLE in history lessons. The questionnaire is anonymous, so the researcher did not know whether children of the parents who made positive comments have good exam results, but the researcher noticed that all negative comments mentioned one particular point—their children failed to show measurable gains in exam results. As the researcher stated in Section 2.3.2, some parents in China always place great emphasis on their child's exam results, and no matter what study method is used, no matter how meaningful the learning process, they always use the exam results to evaluate their child's achievement.

4.5 Analysis of Homework Assignments and Test Scores

To investigate students' learning outcomes with different teaching and learning methods, the researcher compared the results of homework and test scores for the SOLE group and non-SOLE group.

To help students to consolidate the key knowledge points they had learned during the day, students had to finish their homework assignments distributed by Teacher A after each lesson and hand it in the next morning. All students in both the SOLE group and non-SOLE group had to answer the same question independently for homework, and Teacher A and the researcher would correct them one by one. As mentioned in Section 3.5.5, Teacher A and the researcher did not give the completed homework a grade or provide detailed feedback on students' exercise books, only checked whether the homework had been done, and put a tick next to right answers and a cross next to wrong ones. The researcher recorded the noteworthy information (i.e. the questions which were answered wrongly by most of the students) in the notebook.It is important to note that we collected homework from students in the non-SOLE group and we found that none of them used network resources in the home to complete their homework, because they copied verbatim the text in the textbook to answer homework questions (a minority of students in the SOLE class also did it). Similarly, according to the feedback from students and their parents of the SOLE group, most of the students completed their homework without the use of the Internet, but a small number of students still used network resources as in the SOLE class to solve problems which they did not understand. The results can be seen in Section 4.5.1.

Before the start of the experiment, the school office sent the researcher the exam results from July 2014 for all the students in the same year level to help the researcher select two classes to take part in the study. In addition, the results for three exams taken during the research period are recorded and analysed in Section 4.5.2.

4.5.1 *Assessment of Homework Assignments*

(1) SOLE Group

Students in the SOLE class and non-SOLE class needed to complete a set of exercises covering the important points they had learnt from the lesson, and they had to complete them individually in the home. The history exercises included Multiple Choice (MCQs) and essay questions. It was found that students in the SOLE group could answer MCQs with a high degree of accuracy. 'Big questions' were not specifically designed for the MCQs, but students needed to answer these questions based on the knowledge they mastered from big questions, such as facts about time, people, places, events. Teacher A thought this could indicate that students had mastered the important knowledge they gained in the class, because the answer to each of the Multiple Choice questions could be found in those big questions posed by Teacher A in the SOLE class. Furthermore, in the course of time, there was evidence that most students improved their ability to structure an essay answer. For example, after the second SOLE class (26.09.2014), when students answered the question 'what were the causes and results of The First Sino-Japanese War', most of them only summarised three reasons and two results using simple sentences, and only a small number of them tried to remember the contents they had learned online and write down a detailed explanation. However, after the eighth SOLE class (20.11.2014), a similar type of question was asked , i.e. 'what were the causes and results of The Northern Expedition ', and students could explain this question point by point, and pay more attention to who, when, where, what, why and how in the answer. In addition, based on the teaching objectives and teaching plans, Teacher A posed some big questions such as 'How to assess the importance of…', 'Which was more significant in relation to …', 'Briefly explain what is meant by…', 'What can you learn from…', 'Compare and explain…', 'What is the meaning of…', 'Outline / Summarise…', and 'Clearly point out connections or relationships between…and...'. Gradually, students became familiar with how to retell a historical event using examples and relevant facts, and they could answer these questions using clear logical thinking and accurate terms, and structure their answers in a chronological order. Teacher A thought it could be because students gradually improved their

critical thinking skills in a SOLE (see Section 4.3.1), and they understood how to generalise the main ideas of the information which they founded online. This process instilled techniques for answering test questions into their mind.

However, some negative performance on homework assignments also occurred. Firstly, a small group of students did not know how to describe a historical event with the key words in the first lessons, and they always tried to write down all the information they found online. Teacher A claimed that these students 'wasted time' giving a paragraph of background that had little to do with the question, if students answered questions in the examination in this way, they might not have the best scores. However, for the researcher part, the researcher also cared about how good were their abilities to explore and remember information in the SOLEs, and the above situation showed that the SOLE method could help students to remember more information than the teacher expected, and they just had great enthusiasm to bring in some other relevant topics they feel like talking about. However, the main concern voiced by students, teachers, and parents was how to enhance exam scores, and obviously, teachers will not give marks if students answer questions in this way.

Secondly, when students tried to find out more about historical events and answer their questions online, they could get varied and even conflicting appraisals of related events using the Internet, and these represented a range of opinions because different contributors had different positions and attitudes. It is noteworthy that Teacher A, or the vast majority of history teachers, would not encourage students to discuss politically sensitive issues in their homework or examination, as if students did this, they could not get a high mark for it. Students were advised to be led by the mainstream social values, and were advised not to discuss some touchy historical topics such as The Great Proletarian Cultural Revolution/GPCR (1966–1976) (e.g. what were the effects the GPCR in China? how did it change China? do you think it was a complete mistake? If yes, what mistake did it make?). Students just needed to know the development process of this event, and should not appraise

and discuss it in the exam-oriented education system. This may undermine the value of SOLEs. It is hard to judge whether it was right or wrong for students who understood some politically sensitive issue as a result of using the SOLEs , but Teacher A thought in this situation students did not use the Internet resources in an appropriate and balanced way to acquire knowledge.

(2) Non-SOLE Group

Students in the non-SOLE group had lessons with the same learning content as the SOLE group, but the only source of information they were provided with was their textbook. The same homework was assigned after each class, and they also needed to complete the assignments individually. Teacher A and the researcher corrected their exercises carefully, we compared their homework and found that compared with the SOLE group, students could also have a good performance on the Multiple Choice questions about the basic history concepts, but they could not get a high accuracy on the Essay questions.

The non-SOLE group students understood that they should coherently answer Essay questions and use some examples or quotes to support the general statements, and they had the ability to describe a historical event concisely. However, they could only answer those questions for which correct answers could be copied directly from the textbook, and they had not encountered a variety of opinions about a historical event in the way the SOLE group had. In other words, students in the non-SOLE group achieved the requirement of the Chinese Ministry of Education for eighth-grade students, but compared with the SOLE group there were some obvious lacks.

4.5.2 *Analysis of the Examination Results*

When the researcher realised that students in these two classes answered Essay questions in different ways, the researcher decided to record their test scores separately for the Multiple Choice and Essay questions to investigate whether their performances would show differences

under those two conditions.

As mentioned in Section 3.6, the administrative assistant of this junior high school sent the researcher the average scores for each class in this grade for the previous school year to help the researcher and two teachers to choose suitable research participants (students). Teacher B taught Class (3) and Class (7), and these two classes were selected as our research participants. The members of each class were the same in the year of the study (September 2014) as they were in the previous year (July 2014), but one student transferred after November 2014 from Class (7).

Rankings	1	2	3	4	5	6	7	8	9	10
Scores	73.52	73.27	72.85	71.60	71.33	69.72	67.59	67.32	67.27	67.20
Class	(2)	(1)	(9)	(4)	(6)	(5)	(3)	(10)	(7)	(8)
Teacher	Mr. a	Mr. a	Ms. b	Mr. a	Ms. c	Ms. b	A	Ms. c	A	Ms. b
							Control Group		SOLE Group	

Table 4.4: Final examination ranking of history in grade 7, July 2014

This study was conducted in an ordinary school, and according to Section 2.3 we know that ordinary schools in China are largely exam-oriented, all students acquired the same knowledge and information from their teachers based on the contents of the textbook, so there was unlikely to be a huge difference in students' test scores between the SOLE group and non-SOLE group before we conducted the experiment. The examination results would allow us to compare changes in the non-SOLE and SOLE groups after the experiment.

During the experiment, students took three exams in November 2014, January 2015, and May 2015. These three examination results in the two semesters were recorded by the researcher personally. As we discussed in Section 4.5.1, due to the observation that students in these two classes answered homework Essay questions very differently, the researcher decided to record the test scores for the Multiple Choice and Essay questions separately to investigate whether

their performance in the examination would show any differences for these two types of question.

(1) Three exam results for the SOLE group

Paired Samples Statistics[a]

		Mean	N	Std. Deviation	T	df	p
Pair 1	HISTORY(1)	67.8421	57	18.08688	-2.653	56	.010
	HISTORY(2)	71.8070	57	16.34717			
Pair 2	HISTORY(1)	67.8421	57	18.08688	-6.268	56	.000
	HISTORY(3)	76.9123	57	14.56915			
Pair 3	HISTORY(2)	71.8070	57	16.34717	-3.479	56	.001
	HISTORY(3)	76.9123	57	14.56915			
Pair 4	Multiple choice(1)	29.7193	57	7.99499	-1.463	56	.149
	Multiple choice(2)	30.9825	57	6.83607			
Pair 5	Multiple choice(2)	30.9825	57	6.83607	-2.460	56	.017
	Multiple choice(3)	32.9474	57	5.35997			
Pair 6	Multiple choice(1)	29.7193	57	7.99499	-3.743	56	.000
	Multiple choice(3)	32.9474	57	5.35997			
Pair 7	Essay question(1)	38.1228	57	11.00661	-2.683	56	.010
	Essay question(2)	40.8246	57	10.70735			
Pair 8	Essay question(2)	40.8246	57	10.70735	-3.097	56	.003
	Essay question(3)	43.9649	57	10.17168			
Pair 9	Essay question(1)	38.1228	57	11.00661	-6.732	56	.000
	Essay question(3)	43.9649	57	10.17168			

a. GROUP = SOLE Group

Figure 4.8: Three history exam results for the SOLE class

The researcher used the pair samples t-test to test the mean of pairwise differences for three examinations, including the overall test results, Multiple choice results and Essay question results (N=58 in the first exam, but one student transferred after the first exam, so N=57 automatically in the Paired Samples Statistics). Figure 4.8 indicates that each time the mean scores in the History test (Pairs 1, 2 and 3) are higher than in the previous test (67.84, 71.81, and 76.91), and the p-value of every paired sample is less than 0.05 (0.010, 0.000, 0.001). Thus, it can be concluded that there is a statistically significant difference in total scores between exam 2 and exam 1, exam 3 and exam 2 and exam 3 and exam 1.

The exam consists of both Essay questions and Multiple Choice questions, so to investigate whether there are any differences in the performance on these two questions types, one pair samples t-test was carried out for the Multiple Choice questions, and a separate pair samples t-test for the essay questions. The p-value for each of these paired samples is less than 0.05 except Pair 4 (p=0.149). Therefore, it can be concluded that there is a significant difference between the paired tests for both Multiple Choice and Essay questions apart from the first pair of Multiple Choice tests.

(2) Three exam results for the control group

Paired Samples Statistics[a]

		Mean	N	Std. Deviation	T	df	p
Pair 1	HISTORY(1)	70.4098	61	16.32828	-.300	60	.766
	HISTORY(2)	70.9180	61	15.97737			
Pair 2	HISTORY(1)	70.4098	61	16.32828	-1.906	60	.061
	HISTORY(3)	72.7705	61	15.08464			
Pair 3	HISTORY(2)	70.9180	61	15.97737	-1.392	60	.169
	HISTORY(3)	72.7705	61	15.08464			
Pair 4	Multiple choice(1)	29.4426	61	7.78144	-.954	60	.344

123

	Multiple choice(2)	30.3279	61	7.14778			
Pair 5	Multiple choice(2)	30.3279	61	7.14778	-1.600	60	.115
	Multiple choice(3)	31.4754	61	6.89832			
Pair 6	Multiple choice(1)	29.4426	61	7.78144	-2.118	60	.038
	Multiple choice(3)	31.4754	61	6.89832			
Pair 7	Essay question(1)	40.9672	61	10.65984	.304	60	.762
	Essay question(2)	40.5902	61	9.88834			
Pair 8	Essay question(2)	40.5902	61	9.88834	-.709	60	.481
	Essay question(3)	41.2951	61	9.39742			
Pair 9	Essay question(1)	40.9672	61	10.65984	-.352	60	.726
	Essay question(3)	41.2951	61	9.39742			

a. GROUP = Control Group

Figure 4.9: Three history exam results for the control class

Figure 4.9 also uses the pair samples t-test to test the mean of pairwise differences for three examinations. It shows that each time the mean scores for the History test are higher than the previous test (70.41, 70.92, and 72.77), but the p-value of every paired sample is more than 0.05 (0.766, 0.061, and 0.169). Therefore there is no statistically significant difference in total scores between exam 2 and exam 1, exam 3 and exam 2 and exam 3 and exam 1.

As with the SOLE group, a pair samples t-test was also carried out for the Multiple Choice questions part of the test, and a separate pair samples t-test for the essay questions, and the p-value of every paired sample is greater than 0.05 except for Pair 6 (p=0.038). Therefore, there was a small improvement, but it was not statistically significant.

(3) Comparison of the exam results for the SOLE group and control group

The exam results were then compared for the two groups using independent samples t-test.

The results are summarised in figure 4.10, and figure 4.11, 4.12 and 4.13 below.

Group Statistics

GROUP		N	Mean	Std. Deviation	T	df	p
HISTORY(1)	SOLE	58	67.1207	18.75051	-1.022	117	.309
	Control	61	70.4098	16.32828			
Multiple choice(1)	SOLE	58	29.4138	8.25904	-.020	117	.984
	Control	61	29.4426	7.78144			
Essay question(1)	SOLE	58	37.7069	11.36015	-1.615	117	.109
	Control	61	40.9672	10.65984			
HISTORY(2)	SOLE	57	71.8070	16.34717	.299	116	.766
	Control	61	70.9180	15.97737			
Multiple choice(2)	SOLE	57	30.9825	6.83607	.508	116	.613
	Control	61	30.3279	7.14778			
Essay question(2)	SOLE	57	40.8246	10.70735	.124	116	.902
	Control	61	40.5902	9.88834			
HISTORY(3)	SOLE	57	76.9123	14.56915	1.515	116	.132
	Control	61	72.7705	15.08464			
Multiple choice(3)	SOLE	57	32.9474	5.35997	1.288	116	.200
	Control	61	31.4754	6.89832			
Essay question(3)	SOLE	57	43.9649	10.17168	1.482	116	.141
	Control	61	41.2951	9.39742			

Figure 4.10: Comparison of the history exam results for the two groups
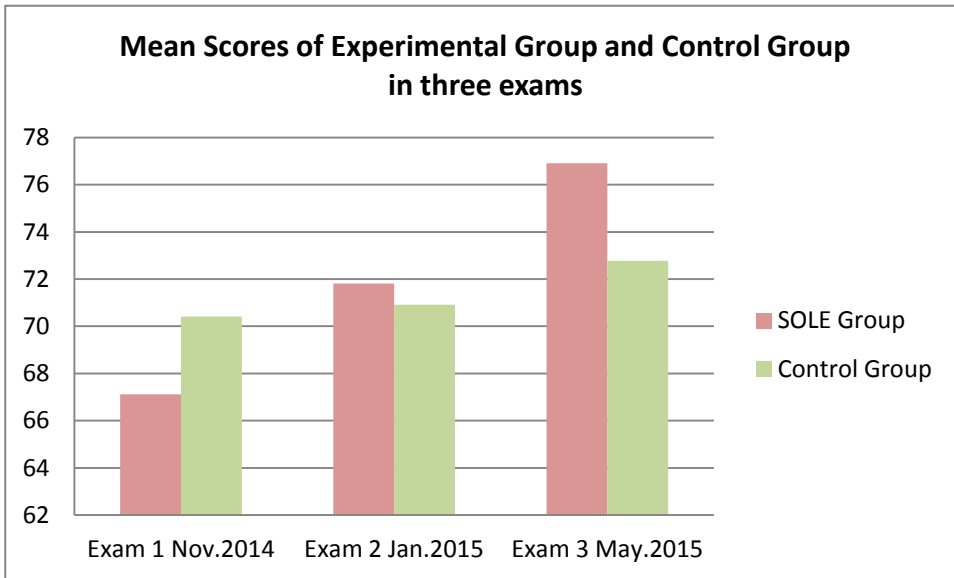
Figure 4.11: Mean overall scores for the two groups in three history exams
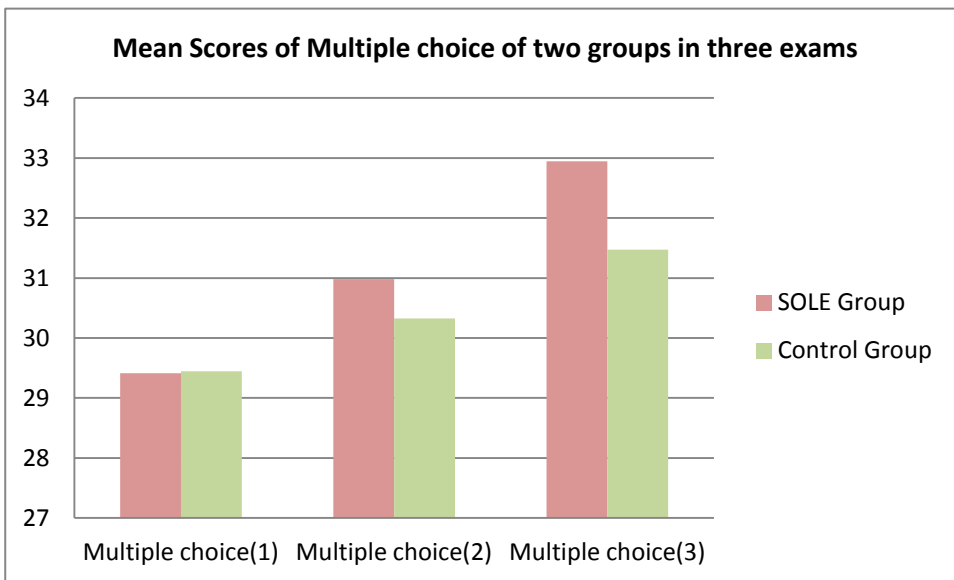
Figure 4.12: Mean scores for the multiple choice section for two groups in three exams

Mean Scores of Essay questions of two groups in three exams
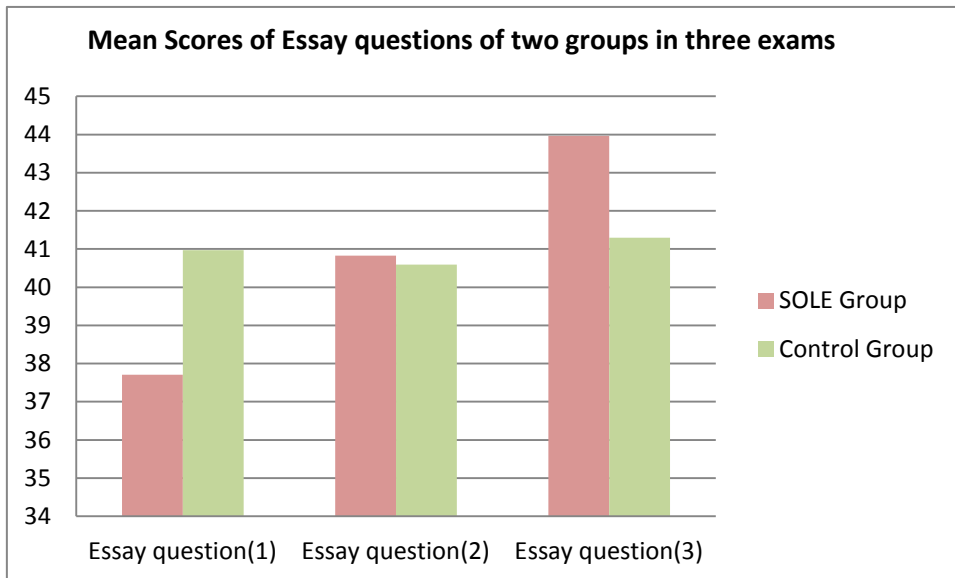
Figure 4.13: Mean scores for essay questions for the two groups in three exams

In the first examination, November 2014, after six SOLE lessons, students in the SOLE group still have a lower mean score than the control group (67.12 < 70.40), and their performance on the Multiple Choice and Essay questions is inferior to that of the control group. However, students in the SOLE group get higher scores (71.81>70.92, 76.91>72.77) in the second (January 2015) and third exams (May 2015), both for the Multiple Choice and Essay questions. However, in all conditions the p-value is more than 0.05, so although there was some improvement, there is not a statistically significant difference between the results for the SOLE class and the control group.

It should also be noted that students in this grade only needed to answer the short essay questions in the classroom and in their homework to demonstrate mastery of the relevant knowledge, but in the exams they also had to answer some material analysis and historical cartoon questions which were not practised in class or at home. In essence, the exam questions covered all the points they had learned in class, but students had to analyse and answer questions step by step, comprehend and explain the issues mentioned in the sources, and interpret the message or meaning of a cartoon using the relevant information they had learned. This situation meant that exams were more challenging than their class exercises and homework.

Statistically, there is no significant difference for the two groups, because according to the Teaching Plan Schedule designed by the Chinese Education Department, students only need to grasp some basic knowledge of historical events in the junior high school, and they will repeat the same history course with a deeper understanding in the senior high school. Thus, in the examination, students would get the required marks as long as their answers included the keywords. Against the background of exam-oriented education, students in the SOLE group could not only get the basic marks on those questions, but could also expand their answers with more discussion and excellent statement. The researcher discussed the results with Teacher A and the other three history teachers in the eighth grade. On looking more closely at the students' answers to the exam questions, as well as meeting the basic requirements for the exam, there was evidence that, in the essay questions, the SOLE group provided longer and more detailed answers than would have been expected. The teachers explained that if they asked a senior high school teacher to evaluate students' examination papers using criteria for a higher level, students in the SOLE group would be given higher scores on the Essay questions than the control group. All four history teachers thought that students in the SOLE group could answer test questions at a level at least 2 years ahead of their time and obtain acceptable test scores.

The exam results for November 2014, January 2015, and May 2015 for all 10 classes in eighth-grade were then compared.

Rankings	1	2	3	4	5	6	7	8	9	10
Scores	74.15	74.13	73.02	71.09	71.06	70.87	70.41	67.12	66.54	63.06
Class	(1)	(2)	(9)	(6)	(4)	(5)	(3)	(7)	(10)	(8)
Teacher	Mr. a	Mr. a	Ms. b	Mr. c	Ms. a	Ms. b	A	A	Ms. c	Ms. b
							Control Group	SOLE Group		

Table 4.5: Mid-term examination ranking of history in grade 8, November 2014

Rankings	1	2	3	4	5	6	7	8	9	10
Scores	74.27	73.41	72.52	72.05	71.81	71.52	71.32	70.92	67.27	67.20
Class	(2)	(1)	(4)	(9)	(7)	(6)	(5)	(3)	(8)	(10)
Teacher	Mr. a	Mr. a	Mr. a	Ms. b	A	Ms. c	Ms. b	A	Ms. b	Ms. c
					SOLE Group			Control Group		

Table 4.6: Final examination ranking of history in grade 8, January 2015

Rankings	1	2	3	4	5	6	7	8	9	10
Scores	76.91	74.51	74.02	73.95	72.94	72.90	72.77	70.92	68.80	67.35
Class	(7)	(1)	(2)	(4)	(6)	(9)	(3)	(5)	(10)	(8)
Teacher	A	Mr. a	Mr. a	Mr. a	Ms. c	Ms. b	A	Ms. b	Ms. c	Ms. b
	SOLE Group						Control Group			

Table 4.7: Mid-term examination ranking of history in grade 8, May 2015

Tables 4.5, 4.6, and 4.7 show that the ranking of the SOLE group improved from 8th to 1st between the November 2014 and May 2015 exams. When students took the third set of exams in the May of 2015, we had completed 17 History lessons with both the SOLE group and control group. Students completed another three SOLE lessons as planned within the following two weeks, but were not asked to take a further examination, though we continued to observe their classroom performance, collect diary feedback, and note the homework results for the last three SOLE lessons.

4.6 Three Examples Lessons

20 History lessons were observed in the SOLE class. To provide a picture of what happened in those classes, three lessons have been selected for description here. The first, tenth and final lessons were chosen in order to show what changes, if any, took place as the course progressed.

4.6.1 *Report 1—First course observation*

Date: 19.09.2014

Main Discussion Topic: History of the Old Summer Palace (1709-1860)

Groups: 58 students, 8 groups of 6 students + 2 groups of 5 students;

Number of laptops: 56 prepared in the Classroom, 10 used;

Firstly, the researcher had already explained in detail how a SOLE should be conducted to History Teacher A. I explained that students should form their own groups, and be allowed to talk within groups and also with other groups, but Teacher A was worried that she could not manage the class in that way, and felt that they would need around three lessons to adapt to the SOLE environment. Thus, students were allowed to talk within groups and also with other groups, but they were not allowed to organise themselves into groups in the first SOLE lesson.

Secondly, the researcher did not have the ability to set up a SOLE environment as Mitra did with the number of computers available to the students (Mitra et al., 2010; Mitra and Arora, 2010; Mitra and Dangwal, 2010; Mitra and Quiroga, 2012), so they had to bring laptops from their own family to every class. After communication with the headmaster, the school confirmed that they could provide access to the Internet, but no Wi-Fi, so broadband cables were distributed in the classroom. We did not know whose laptops would run faster and connect reliably to the Ethernet, so students were told to decide, after testing, whose laptop would be used, and carry out a SOLE task with one laptop per group. In the later lessons,

students always discussed in advance who would bring the laptop next time, and took turns.

Questions posed by Teacher A:

Teacher A took about two minutes to show a slide with five questions she designed based on her lesson plans and course contents, and told her students what she expected them to complete before the class ended.

1. Where is the Old Summer Palace?

2. When did construction of the Old Summer Palace begin?

   Moreover, why was it built?

3. What were special features of the Old Summer Palace?

4. What was happening from 1856 to 1860 here?

5. If you have the opportunity to introduce the Old Summer Palace to the foreigners,

   how will you describe it?

Classroom observations:

There should be no intervention from Teacher A and the researcher during the SOLE class, and we should keep silent and only walk around the classroom observing students' work and taking some notes, unless students asked for help. However, due to this being the first SOLE class, Teacher A could not always help giving her opinions to students while they were doing the SOLE tasks. For example, she directly asked those students who remained silent in the group to voice their opinions, and also directly told some students how to use the right keywords to find the answers of those questions. We talked about this situation after this class and Teacher A gradually adapted to the SOLE method in the classroom in later lessons.

(1) Positive aspects:

Most students could discuss the above questions with great enthusiasm, they found lots of interesting reading material on this topic by themselves, and took responsibility for a

particular role, so that one student operated the laptop, some of the others discussed the key information, and the rest of them took notes. They decide these roles themselves. Teacher A and the researcher did not advise them to take on any roles. Following the normal SOLE procedure discussed in Section 4.3, Teacher A and the researcher listened to their discussions and gave them 10 minutes to share the information they had collected and important notes they had made with other students. Teacher A evaluated the performance of each group, and we found in the first SOLE lesson most students appeared to have understood, and could give a clear explanation of, the information they had acquired online.

(2) Negative aspects:

Eight students did not work with other members of the group. Instead, they used their own laptop covertly to browse entertainment news and tried to play web games. Teacher A got angry about it, and to avoid the same situation in the later lessons, we asked students to power off all backup laptops except those which would be used in the SOLEs.

Some students needed to learn how to improve their ability to search for information via the correct keywords. For example, rather than type 'When did construction of the Old Summer Palace begin?' into the search bar, it would have been more efficient to type 'construction time, Old Summer Palace' as the keywords. The researcher even found three students who typed Question 5 word for word into the search bar, so we thought students still needed more time to explore, understand, and slowly find their own ways to learn in the SOLEs.

The researcher wanted to wait to see if they discovered it by themselves, but Teacher A intervened in this class and told these students how to choose a key word. The researcher will describe the skills and strategies we used to help the students learn more efficient ways of searching in Chapter 6.

In the last 10 minutes of this lesson, Teacher A invited some students to share a summary of the answers they had found by searching on the internet, and the researcher felt the students

were not good at providing summaries, maybe because they were used to reading the simple sentences describing historical events in the textbook, and did not know how to brief summarising the main and subordinate points from online resources. For example, when they tried to answer Question 3, what special features of the Old Summer Palace were, one student spent about 2 minutes reading the detailed description online word by word. If they had been working on learning this question in a conventional class, they would only have needed to remember three sentences in the textbook to describe its features. After all, it is hoped students could acquire and master new knowledge other than the textbook, but they have to improve their capacity to summarise information.

Feedback:

After the class, Teacher A assigned a set of exercises as homework, included Multiple Choice and Essay questions, and all these exercises could be completed using the knowledge they had acquired in class. The teacher and the researcher corrected their homework, and a majority of students finished their homework with a high rate of accuracy. It seemed that students completed their homework with the help of their notes recorded from online resources, and Teacher A was satisfied with the work they had done. In China, many students cannot follow the teachers in class, so they plagiarise the homework, this is a common phenomenon. Teachers always spent a lot of time and energy trying to spot whether homework was the student's own or plagiarised. The only issue was, Teacher A thought that some questions could be answered clearly within a short paragraph, but many students responded to queries with verbose explanations.

According to the diary feedback, both students and Teacher A expressed a high level of satisfaction with the SOLE method. Teacher A claimed that they achieved all her teaching objectives, and she was confident that students had understood those important problems they needed to learn about this topic. The only complaint from Teacher A was about the chaotic classroom in the SOLEs. She did not like the noise, but she said she would adapt to the SOLE

classroom as quickly as possible.

Some students told the researcher that they did not complete all questions in the SOLE lesson, because they did not have enough time to write down all the information they found online, and they were not familiar with how to find the correct answers when the time was limited. Some of them said they wanted to organise themselves into groups, and they wanted to discuss questions with their friends because they were shy about expressing their opinion or suggestions with students in groups arranged by Teacher A. Of course, this problem was solved in the later lessons.

4.6.2 *Report 2—Tenth course observation*

Date: 04.12.2014

Main Discussion Topic: The "Three Great Battles" (1948-1949)

Groups: 57 students; Self-organised into groups, 4-6 students every group;

Number of laptops: 38 prepared, 12 used;

Questions posed by Teacher A:

Teacher A took about two minutes to show a slide with these three questions to students, and told them what she expected them to complete before the class ended.

1. Summarise the events of the Liaoshen Campaign;
2. Summarise the events of the Huaihai Campaign;
3. Summarise the events of the Pingjin Campaign;

Classroom observations:

The class procedures were the same as in the first SOLE lesson, as explained in Section 4.6.1. In this lesson, two students from different groups raised their hands to ask for help because they were unsure how much detail they should include in their summaries for these three

questions, and Teacher A gave them a few tips.

(1) Positive aspects:

It was the tenth SOLE lesson, and as the course progressed, the students had gradually mastered some efficient ways of searching for key information online. Now students could present a brief abstract of the main ideas relevant to the questions using information from online resources, and they could compose a concise answer covering the highlights and the relevant details. This represented significant progress compared to the first SOLE class. For example, Teacher A asked them to summarise the events of the Liaoshen Campaign, and most of the groups could find information by entering accurate keywords online, and they could summarise the answers using information about time, place, and character, and explaining the causes and effects.

Students were allowed to form groups by themselves, and they could learn with their team members together, they could move around in the classroom to look at what other groups did, and they also could change group at any time if they liked. Students were becoming more and more familiar with the SOLEs, and were also more active than before. Basically, all students appeared to concentrate on the learning and discussion, and no students did things which were not related to the class.

(2) Negative aspects:

Teacher A said it was a little difficult for students to integrate all the valuable information about these three questions from different web sites because the topic of 'Three Great Battles' was complicated. According to our counting, before the class ended, there were 13 students who said they did not complete the task due to spending too much time on the first two questions, and they did not search for any relevant information about the final question, just using the answers from other groups.

Feedback:

A set of exercises with Multiple Choice and Essay questions was assigned as usual, and all questions were related to the knowledge they should master on the day. Teacher A expressed the view that today's topic was a hard one for students, but students in the SOLE class tended to do better on homework than those students she taught before, and students could answer questions with detailed description better than students in the non-SOLE group. Although some of the students did not complete their task in the class, the diary feedback told the researcher that some of the students did continue searching for these questions online at home, and some of them did it with their classmates after the class, and finally most of them were able to complete the homework and understand the important and difficult points on this topic.

In the diary form, Teacher A admitted that she did not complete her original teaching plan. She hoped all groups could solve these three problems in the class, but around a quarter of students did not complete the task. However, she was satisfied because it was one of the hardest chapters in this semester.

Conversely, the students' Diary feedback was full of positive words. They felt satisfied with their performance in the SOLE class, including those students who indicated that they did not complete the task due to lack of time. They enjoyed sharing resources with other groups to help them understand those complex questions quickly and easily.

4.6.3 *Report 3—Twentieth course observation*

Date: 29.05.2015

Main Discussion Topic: The Great Scientific and Technical Achievements (1950s-2001)

Groups: 57 students; Self-organised into groups, 4-6 students every group;

Number of laptops: 16 prepared, 11 used;

Questions posed by Teacher A:

Teacher A took about two minutes to show these five questions to students before they began the SOLE tasks, and told her students what she expected them to complete before the class ended.

1. What was the most important contribution from Deng Jiaxian and Yuan Longping?

2. (1) What is the value of the 'Two bombs and one satellite' event?

   (2) What was happening in 1960, 1964, 1967, and 1970?

3. (1)What was the '863 program'?

   (2) What specific technological areas were developed by the '863 program'?

Classroom observations:

There was no intervention from Teacher A and the researcher in this class.

(1) Positive aspects:

Students got their mid-term exam results two weeks ago. This SOLE class ranked first out of all the classes in this grade, and they were excited about this for a long time. They appeared to apply themselves to the SOLE tasks, and Teacher A also gave students high praise for their progress.

No matter what questions were asked now, students were able to correctly determine the keywords for a complex question, rather than type the whole question into the search box like in the first SOLE lesson. Students had thoroughly grasped the skill of marking all key words in questions before searching online, sometimes they also discussed with students from other groups about what keywords should be used. They could present answers in terms of major points followed by clarifying details or facts. They understood how to summarise the basic concepts and consequences in a short paragraph. When a little elaboration is necessary, such as for Question 3, students understood how to filter information and summarise the major points to answer the question.

(2) Negative aspects:

No special negative issues occurred in this class. In fact, there had been no more negative issues in the SOLE class since the 14th lessons.

Feedback:

Teacher A was almost always satisfied with their homework because students performed very well. According to the diary form, most students said that although this was the last SOLE Class, they expected to continue using this method to learn history in the future. Some students claimed that their parents would like to support them using the computer to study, no matter for what subjects. At the same time, Teacher A stated that learning in the SOLE is by no means perfect, but is an excellent choice to help students make some progress. She indicated that the traditional role of teacher conflicts with the SOLE approach, but she was able to take on a different role over time and still identify students' needs in order to provide appropriate help for them.

4.7 Chapter Summary

This chapter provides a discussion of the SOLE method used in twenty history lessons. According to the feedback from students and teachers, it appears that most of them enjoyed learning History in the SOLEs. Although the parents did not have a positive attitude to the SOLEs before this experiment, they were willing to encourage their children to learn in the SOLEs after students got higher scores in the exams. Compared with the non-SOLE group, students in the SOLE group were able to produce answers to essay questions at a level two years ahead of their time. Students in the SOLE group perform better on their homework tasks, they made significant progress in three exams, and the SOLE class improved their rank from 8th to 1st among the eighth-grade classes. In the next chapter, the analysis will focus on the classroom observation with the maths lessons in the SOLEs.

Chapter 5. Maths Lessons in the SOLEs

5.1 Introduction

This chapter discusses the application of the SOLEs in the maths lessons. There are seven sections in this chapter. Section 5.2 presents details of the course design and schedules of 20 maths lessons, including 9 Plane Geometry lessons and 11 Algebra lessons. Section 5.3 describes the reactions of Teacher B and the students to the SOLE method, and discusses the teacher's role and her specific tasks in the SOLEs. Some typical opinions and advice from the teacher, students, and the parents are presented in Section 5.4. Details of Homework assessment and Test scores analysis are discussed in the next section. The last section provides detailed accounts of two Plane Geometry lessons and two Algebra lessons based on classroom observation data.

5.2 Course Design and Learning Arrangements

According to the teaching programme of China's Ministry of Education, eighth-grade students are supposed to learn some basic maths knowledge and maths skills to help them solve some real-life practical problems. Maths teachers should make great efforts to cultivate the students' arithmetical ability, logical thinking, and the skills needed for analysing and solving problems.

Eighth-grade students were asked to master the relevant knowledge about plane geometry and algebra in the course of the school year 2014/2015. For plane geometry, students had to understand the definition and application of all kinds of geometric figures such as the triangle, polygon, rectangle, diamond, square and trapezoid, and they should build their skills to calculate and solve practical problems. For algebra, students were required to learn the concepts and arithmetic of integral expressions, fractions, and quadratic radial. Similarly, graphs and analytic expression of linear functions were also important. Based on the curriculum requirements, the maths Teacher B (anonymous) and the researcher conducted 9 plane geometry lessons and 11 algebra lessons in the SOLEs.

First Semester:

Date	Lesson	Main Discussion Topic
08.10.2014	Plane Geometry	Triangle and Equilateral triangle
22.10.2014	Plane Geometry	Axis of symmetry and symmetric figure
Mid-term examination week (04.11.2014—07.11.2014)		
10.11.2014	Plane Geometry	Polygon and Interior angle sum
18.11.2014	Algebra	Multiplication of Integral Expression
25.11.2014	Algebra	Formula for the difference of squares
03.12.2014	Algebra	Formula for Perfect square trinomial
05.01.2015	Algebra	Comprehensive exercises
Final examination week and Winter Holiday		

Second Semester:

Date	Lesson	Main Discussion Topic
05.03.2015	Plane Geometry	Congruent triangles
12.03.2015	Algebra	Fraction
18.03.2015	Algebra	Fractional equation
26.03.2015	Algebra	Quadratic radical
01.04.2015	Algebra	Multiplication and division of Quadratic radical
08.04.2015	Algebra	Addition and subtraction of Quadratic radical
15.04.2015	Plane Geometry	Pythagoras Theorem
23.04.2015	Plane Geometry	Converse theorem of the Pythagorean Theorem
Spring Sports (28.04.2015—30.04.2015)		
04.05.2015	Plane Geometry	Parallelogram
Mid-term examination week (06.05.2015—09.05.2015)		
11.05.2015	Plane Geometry	Basic Properties of Parallelogram
14.05.2015	Plane Geometry	Area and Perimeter of a Parallelogram
21.05.2015	Algebra	Basic Properties of Linear function
27.05.2015	Algebra	Application of Linear function

Table 5.1: Learning arrangements for maths lessons

5.3 Classroom Observation

The SOLE group for maths lessons and history lessons was the same class, and it was a class with 58 students (57 after Nov. 2014) in the eighth-grade. The control group for the maths lesson was a class with 60 students in the same grade, and maths Teacher B taught both of these classes. Thus, it was convenient to observe and compare the behaviour and achievements of students in these two different groups with the same teacher.

The procedures adopted in the SOLE lessons for maths were similar to those described in Chapter 4 for the history lessons. It is worth noting, however, that for the experimental group, the SOLE class, Teacher B had different ways of posing her questions for the plane geometry and algebra lessons. In geometry lessons, Teacher B first took about two minutes to show a slide with questions based on her lesson plans and course contents, and usually no more than seven questions were used to help students grasp all the essential knowledge for the day. However, in the algebra lessons, Teacher B first showed a slide with some questions, and if students were able to solve them quickly, she would write down some new questions on the blackboard whenever necessary. Although those calculations were nothing more than basic arithmetic, the formulas were very complicated. Thus, if students were required to complete their tasks using online resources in a group, the intervention from Teacher B might be needed. It will be discussed in detail in later.

In terms of how the students were expected to work, there was very little difference from history lessons, as they were also required to study in a group of 4-6 to solve problems within about 35-40 minutes using the network resources, and share the information they collected or compare their answers with the other students. Then, the teacher took about 10 minutes to evaluate the performance of each group, give a summary and provide suggestions for their follow-up work.

As a class observer, in the same way as in the history lessons, the researcher should not intervene too much in their study, unless students put up hands to ask for help. However, the intervention was rare in the history lessons but was very common in the maths lessons, as will be explained. Section 4.3 introduced the typical pattern of a SOLE lesson and the researcher's roles in the SOLEs, and similarly, the researcher still repeated the same work in the maths lessons to record Teacher B and students' behaviour, their learning procedures, the classroom atmosphere, and so on.

For the non-SOLE group, the class were taught as usual, and Teacher B also used the same lesson plans to guide students to acquire new knowledge. However, in geometry lessons, the only resources the students had were the textbook containing geometric figures, and Teacher B had to draw these geometric figures herself on the blackboard in order to explain more clearly the relevant properties and theorems. In the Algebra lessons, Teacher B first explained some basic concepts and then asked students to work out maths problems on paper individually. The teacher's role was the same as in the history lessons, as a participant observer in the control group, and the researcher just sat at the back of the classroom and remained silent while the classes went on, without any intervention.

5.3.1 *SOLE Group Students' Reactions*

There were some differences from the history lessons, among them the fact that the students had an ambivalent attitude toward the maths lessons in the SOLEs. They were more interested in solving plane geometry problems than the algebra problems in the SOLEs, because they were motivated by the interesting animations or videos and many dynamic graphics they found to help them quickly understand the relevant concepts for each geometric shape. According to the students' feedback which will be described in Section 5.4.1, it was clear that students enjoyed completing their plane geometry tasks in the SOLEs.

However, most of the students did not find an effective way of learning algebra in the SOLEs. They told the researcher that they could not understand the meaning of certain terminology or some basic concepts in algebra without the help from their teacher, and the internet resources always complicated some simple concepts which only added to their confusion rather helping them understand.

Teacher B and the researcher also tried to search for some relevant algebra animations on the Chinese Web sites but did not find useful materials. We were also exploring some new ways to help the students better integrate themselves into the SOLEs, but students said they were much more willing to study algebra with Teacher B using conventional teaching methods. Students could get more experience to answer questions in the exams if they completed more maths exercises, so they preferred to save as much time as possible to do practice questions offline, in their exercise book. They liked the way Teacher B explained how to work out each algebra problem on the blackboard, rather than directly copying the exact answers from information they found on the internet. For example, when Teacher B asked them to simplify$\sqrt{28}$, most of the students could find the answer $2\sqrt{7}^{'}$ without going through intermediate steps, but they did not know how to get this answer step by step. The students believed that the problem-solving procedure was more important than the final answer in the algebra class, because if the teacher sees their thought process in answering a question, they could get as much partial credit as possible in the exams.

5.3.2 *Non-SOLE Group Students' Reactions*

In contrast to the SOLE class, students who used the conventional learning method performed better in the algebra lessons than in the plane geometry lessons. Students could only view the geometric figures from the textbook, no vivid pictures, and no colourful images. Students in the SOLE class could draw any geometric shapes using simple sketchpad software, and this activity not only saved class time but also was surprisingly fun. However, students in the non-SOLE class had to draw a geometric figure by themselves on paper or use scissors to cut

the paper into a shape.

In the algebra class, they could follow Teacher B to solve complicated maths problems, and write down all problem-solving steps from the blackboard in time. They had more time to do extra class exercises, and difficult problems could be identified and solved by Teacher B immediately.

5.3.3 *Teachers' Role in the SOLEs*

According to the teaching programme of China's Ministry of Education, the day before the SOLE class, Teacher B prepared her lesson plans and designed the questions in the light of the following:

(1) Teaching objectives; (2) Teaching contents; (3) Teaching key points;

(4) Teaching difficult points; (5) Teaching methods; (6) Teaching evaluation;

Teacher B and the researcher also searched for relevant online resources based on listed questions when preparing lessons, and speculated about what resources would be found and discussed by students. Learning maths was different from learning history in the SOLEs, and it was extremely difficult to design algebra problems using the internet resources. Teacher B and the researcher discussed it over and over again, but it was difficult for students to learn effectively in the SOLEs, and Teacher B was at a loss to explain the unsatisfactory learning outcomes. Most of the time, Teacher B had to intervene in their discussion and help students to solve problems otherwise they were unable to move on to next step.

Date	Lesson	Intervention times
08.10.2014	Plane geometry	2
22.10.2014	Plane geometry	2
10.11.2014	Plane geometry	1
18.11.2014	Algebra	8(teacher)+4(researcher)
25.11.2014	Algebra	7(teacher)+2(researcher)

03.12.2014	Algebra	6
05.01.2015	Algebra	2
05.03.2015	Plane geometry	1
12.03.2015	Algebra	2
18.03.2015	Algebra	3
26.03.2015	Algebra	4(teacher)+1(researcher)
01.04.2015	Algebra	5
08.04.2015	Algebra	4
15.04.2015	Plane geometry	1
23.04.2015	Plane geometry	0
04.05.2015	Plane geometry	3
11.05.2015	Plane geometry	0
14.05.2015	Plane geometry	1(teacher)+1(researcher)
21.05.2015	Algebra	7(teacher)+1(researcher)
27.05.2015	Algebra	7

Table 5.2: The number of times that mediators intervened in discussions in maths classes

The researcher gave a count of how many times the mediators intervened in discussions in each SOLE class based on her field notes (Table 5.2). The researcher provided assistance for five classes. In the algebra classes, Teacher B and the researcher intervened in discussions for as many times as students needed. In the geometry classes, students did not need much help from mediators.

During the experiments, the researcher leant FrontPage and JavaScript, so that we could create a web page with multiple choice, true-or-false or fill-in-the-blank questions based on the algebra contents, and students could answer questions online in a group. The feedback for their answers would be given to Teacher B and students immediately after the questions were answered. In addition, we also tried using different learning software to support maths group learning. Students still needed to complete their SOLE tasks as usual, but if they were interested in the webpage we created and the software we recommended, they could do these extra algebra exercises after they finished standard SOLE tasks. This was done for arousing

students' interest in algebra. However, according to the classroom observation, the researcher found that students did not have enough time to do extra exercises, so later this method was not necessary. In this process, Teacher B was not only a mentor and a facilitator as in the history lessons, but she was also a coordinator, organiser, innovator, and learner.

5.3.4 *Teacher's Role in the Conventional Teaching*

Maths is a complicated subject, and Teacher B said she preferred to teach students with the conventional teaching method in the classroom. The teacher could show and describe the maths concepts one by one, and guide students to figure out maths problems step by step. Each maths problem had its precise answer, and the maths teacher believed that she should help students build a logical thought process rather than directly provide the correct answers for them.

5.4 Diary Feedback Analysis

The researcher gave a specific explanation about how to send and collect the diary form in Section 4.4. Section 5.4.1 will provide a detailed analysis of students' feedback, and the analysis of Teacher B's self-reflection will be stated in Section 5.4.2.

5.4.1 *Students' Feedback*

As with the history lessons, after each maths lesson, all students would also be invited to complete a diary form to share their experiences and ideas in the SOLEs. To better compare students' attitudes to history lessons and maths lessons, the same questions were asked, and students could add any questions they had on the form depending on the learning contents of the day (see Appendix E). For example:

· What is the most rewarding part for you in this lesson?

· What is the most challenging and easiest thing in this lesson?

· How many students were in your group? Did you change groups? What did you do? How well did your group members do?

·   Did you find out the answers to all the questions? If not, would you please explain briefly why not?

·   How much of the content have you mastered?

·   What will you do differently next time

Table 5.3 shows a high submission rate but there were always some who failed to submit, and students could submit the diary feedback with their real-name or anonymously as they wished. If someone preferred face-to-face chatting to writing, the researcher could interact with them and keep an audio-record during their break time. Teacher B was very willing to read students' feedback, and she believed that students' opinions could help her to design questions better.

Lesson	1	2	3	4	5	6	7	8	9	10
Sent	58	58	56	57	57	54	57	57	57	57
Returned	46	49	48	50	49	50	47	50	54	43
Lesson	11	12	13	14	15	16	17	18	19	20
Sent	57	57	57	56	55	57	57	57	57	57
Returned	48	48	47	50	53	50	56	52	57	57

Table 5.3: Response rate statistics for students' diary form feedback in maths lessons

A majority of students provided a detailed description of their experience. According to Table 5.3, the researcher received 1004 diary forms in twenty classes: 454 for geometry lessons and 550 for algebra lessons. Students needed to answer 10 specific questions for each diary form, so the researcher filtered the information from 4540 answers for geometry lessons, and 5500 answers for algebra lessons. The researcher categorised their answers by positive, negative, neutral responses and others. In total, for the geometry lessons, there were 1933 positive responses, 206 negative responses, and 79 neutral responses. For the algebra lessons, there were 479 positive responses, 1691 negative responses, and 402 neutral responses.

Here are some typical extracts from their feedback:

Plane geometry lessons:

[Positive]

"There are many interesting pictures about triangles online, and I found that many live items are triangles such as coat hangers, road signs, pyramid, suspension bridge, pocket billiards setup, and *sailing ship… there are not in the book, wonderful!"* (08.10.2014, student-27)

"My group members download four dynamic graphics to help us understand the property of triangles, and it was definitely more interesting than viewing pictures and reading literal interpretation on the textbook." (08.10.2014, student-31)

"Today I learned what the symmetric figures are, butterflies, heart-shaped gifts, sunflowers, and lobsters. I love to acquire geometric knowledge in the SOLEs." (22.10.2014, student-40)

"There are only a few images on the textbook, but our group browsed at least 100 pictures online, and we have mastered how to draw the symmetry axis of symmetric figures in the right place." (22.10.2014, student-33)

"It was so easy to understand how to calculate the interior angle sum of a closed polygon via videos and colourful animated demonstration. The heady concepts become more accessible via SOLE learning." (10.11.2014, student-6)

"I think now I have enough experience to find out valuable information within a short time. I know which websites support downloading dynamic geometric figures, which websites provide a detailed explanation of maths concepts, and which websites upload massive maths exercises, and I have to admit that all of these websites can help me with my lessons." (05.03.2015, student-19)

"There were five classmates in my group today, we worked well off each other, and we did not change to other groups halfway. Teacher B asked us to draw some quadrilaterals via the Sketchpad software, and according to the specific instructions, we together designed different geometric shapes including square, rectangle, parallelogram, kite, isosceles trapezium, and rhombus. We shared our pictures with other groups, and Teacher B praised us. I was very happy!" (04.05.2015, student-23)

[Neutral]

"Today I changed groups for three times. In the first group, one of the classmates occupied the laptop, and he only shared it with his best friend, I had no opportunity to try to search for online resources, unreasonable. In the second group, I found out the converse of the Pythagorean Theorem, and group members were pleased with me about it. We also solved other questions together. I changed again to the third group because we finished all tasks in the second group, but classmates in the third group had some trouble, and they invited me to guide them. Finally, our work being satisfactory, Teacher B praised us." (23.04.2015, student-9)

Algebra lessons:

[Positive]

"It was the brilliant software to do maths exercises. Our group answered 14 questions, the procedure determined right and wrong, and we received the feedback in the first time. We also could know the results from other groups, so interesting." (05.01.2015, student-36)

[Neutral]

"Teacher B asked us to calculate $(2x^3)(-5xy^2)$ and $(-3ab)(-a^2c)^2 \cdot 6ab(c^2)^3$, we solved these two problems on paper, and we think algebra problems have to figure out on paper. However, online recourses offered us a basic comprehension about how to solve these problems based

on its formula.” (18.11.2014, student-24)

[Negative]

“It was a little difficult to understand the literal interpretation of what Exponentiation is via online resources, and I could not retell it by myself. One of the group members summarised its formulas, and this made it easier to understand.” (18.11.2014, student-27)

“We found out useful information about the proof of the factorisation identity, and according to the distributive law, we learnt $(a+b)(a-b)=a^2b^2$? Teacher B asked what is the X and Y within $x^2y^2=1991$, and referred to the formula online, we were sure it should be $(x+y)(x-y)=1991$, but we did not know what the next steps were to solve this problem. We tried to search for similar maths problems online as reference, but we found the same question with right answers directly. We knew the answers but we did not understand how to get these results. Finally one classmate from another group told us how to analyze it and wrote down t each of these steps on paper.” (25.11.2014, student-4)

“Teacher B asked us to calculate $(-4x+3y)^2$, we had no ideas how to solve it, but we find out the formula （a+b）$^2=a^2+2ab+b^2$ online, and we applied this formula to get a right answer. However, we did not know how to calculate $(3x+2y+z)^2$ because there were there monomials in parentheses. We wasted some time here, and we asked teacher B for help, and she told us $(3x+2y+z)^2=[(3x+2y)+z]^2$ and the above formula could be applied next step. Frankly speaking, I do not think learning Algebra in the SOLEs is a wise choice.” (03.12.2014, student-15)

“I think I completed today's task in a conventional method, rather than learning in the SOLE. It was very strange, I am not sure what the online information can do when I do maths problems, I am more used to complete exercises on paper.” (01.04.2015, student-41)

"It was difficult to understand the concepts of quadratic radical online, we still confused about these expression: $\sqrt{a^2 b}= a\sqrt{b}$ (a≥0), $\sqrt{a^2 b}= - a\sqrt{b}$ (a<0),

$\sqrt{a}+\sqrt{b}=\frac{a-b}{\sqrt{a}-\sqrt{b}}$. We cannot understand why the left-hand side of the equation equals the right-hand side, and we really need Teacher B to show the procedure step by step as in the traditional class." (26.03.2015, student-26)

"The lesson contents were complex, and we did not complete all tasks. The maths problems were too difficult for us, we found out the accurate answers without processes of two problems, but it was not useful because we still did not know how to get the right results." (08.04.2015, student-33)

To be sure, students enjoyed doing geometry tasks much more than doing algebra tasks in the SOLEs. The following words were repeated most often in their feedback forms, and their attitudes toward SOLEs with the maths lessons could be summarised as: For plane geometry lessons – Lively (164 times), Readily comprehensible (109 times), Time-saving (91 times), Creative (77 times), Interesting (52 times), and Graphic (31 times). For algebra lessons – Complicated (273 times), Confused (182 times), Difficult (140 times), Dizzy (97 times), and Tedious (72 times). Most students thought that online resources could be effectively applied to the plane geometry lessons, but had a very minimal effect on the algebra lessons, and it was necessary to increase teacher's intervention when they solved algebra exercises.

5.4.2 *Teachers' Reflective Diary*

The researcher used the same technique as in the history lessons to record Teacher B's feedback, included the diary form and immediate reflections about the lesson through audio-recorded chat after the lesson or when she was free while the students were doing the SOLE. Teacher B also liked to record her reflection via handwriting. As with the history lessons the author explained in Section 4.4.2, teacher reflection questions were asked via the

following aspects: (1) Students; (2) Lesson Objectives; (3) Classroom Management; (4) Teacher. The reader could refer to Section 4.4.2 for specific questions listed in the diary form.

Teacher B completed all her twenty diary forms in the SOLE classes (see Appendix F), including 9 for geometry lessons and 11 for algebra lessons. Teacher B needed to answer 18 specific questions and was allowed to add notes for each diary form, so the researcher filtered the information from 171 answers for geometry lessons, and 209 answers for algebra lessons. As students' feedback, teacher B's responses were also categorised by positive, negative, neutral responses and others. In total, for geometry lessons, there were 57 positive responses, 6 negative responses, 39 neutral responses. For algebra lessons, there were 21 positive responses, 91 negative responses, 11 neutral responses.

The following is a typical extract from Teacher B's reflections.

Plane geometry lesson:

[**Positive**]

"Students had performed better than I expected. They never were so active in the class. Group cooperative learning helped students understand the most important knowledge points from different interpretations other than the teachers' prosaic interpretations." (08.10.2014)

"I was satisfied with students' answers to my questions. It surprised me that they found out so many interesting images of triangles. I believe these pictures which are not part of their textbook will help students make better sense of the geometry concepts." (08.10.2014)

"In the conventional class, I have to draw at least five symmetric figures on the blackboard to help students learn to find the axis of symmetry of different figures. It will cost the limited time in class, but we cannot avoid the problem. In the SOLE class, students can browse images in various formats online, and these images make geometry concepts easier to understand. It will be significantly helpful to develop the students' thought and stimulate their imagination in

learning.” (22.10.2014)

“I have been a teacher for 13 years, and in the conventional class, every time I asked students to imagine what items are rectangles in our lives, students always illustrated that the book, flag, window, desk, bed, photo frame, brick, and television are rectangles. Today I also asked students in the SOLE to answer this question, and after they searched for relevant geometric drawing online, they told me the lunch box, goal, perfume bottle, container, abacus, microwave oven, fish tank, swimming pool, bank card are rectangles. For eighth-grade students, they do not need to distinguish plane geometry from solid geometric figures, and they only need to understand the basic concepts of different shapes. I guess they did a good job.” (04.05.2015)

[Neutral]

“I observed students’ performance, and I found some of them were prone to be absent-minded. They did not participate in a discussion and waited for other group members to search for useful information. It was my duty to remind them not to do so, but most of the time their group members did it for me. I think learning in the SOLE is a breakthrough and complement against conventional classroom.” (08.10.2014)

Algebra lesson:

[Positive]

“In the conventional class, I always guided students to solve problems step by step via blackboard, and most gave students 10 minutes to do some extra exercises related to teaching contents on that day. After students completed the class exercises, the teacher would tell them the correct answers and dismiss the class, and no time to show the exhaustive process of these exercises. In the SOLE, although students could not follow the teacher to learn how to calculate a case step by step, they could self-check their answers with classmates in the group or other groups, and ask someone’s advice if they realised own mistakes. It was beneficial to

improve their subjective sense and self-learning abilities. ” (03.12.2014)

“I found students had much passion for doing maths exercises with their group members together. No matter what types of web-based exercises for Algebra were created via FrontPage, JavaScript, or Hot Potatoes, it was an effective tool to help students improve their self-learning skills. ”   (08.04.2015)

[Negative]

“Almost everything students do in a maths lesson will depend on knowledge points that they have previously learned. It will be not easy to learn something new if students could not acquire and master all critical teaching points and difficult points of the day. At present, I still do not know how to design appropriate maths questions to let students throw themselves into the SOLE, and the classroom learning results are not ideal. The maths teacher should keep informed of students' needs to provide an adequate guide and help to them. However, although we have realised there is a little bit of a problem in the SOLE class, we have no idea where to start looking for the solution. ”   (25.11.2014)

“I think I did not complete the teaching objectives today. According to the discussion from students, I realised that two of teaching important points and one of teaching important points were not being mastered by students. In fact, I do not think the application of the formula for Perfect square trinomial is difficult for them, but if I did not intervene in and guide them towards algorithms, students could not understand learning contents completely. This situation never happened in the conventional class. I will evaluate their assignments tomorrow, and assess their learning quality. ”   (03.12.2014)

In general, Teacher B thought that she had to intervene in the discussions when students did their algebra tasks, and online resources could not be effectively applied to algebra lessons. However, she would encourage students to learn geometry in the SOLE, because students

could learn better from Internet resources than textbooks.

5.4.3 *Parents or guardians' responses*

In Chapter 4, the researcher had discussed the parents' general views about the SOLE method and how they thought about the application of the SOLE in the history lessons. In this section, the researcher will focus on sharing some parents' ideas and advice on the maths lessons. Teacher B and students had different views on the plane geometry lessons and algebra lessons, and at the end of the experiment, the parents were also invited to answer five questions to express their opinions about learning in the SOLE to solve the plane geometry and algebra problems.
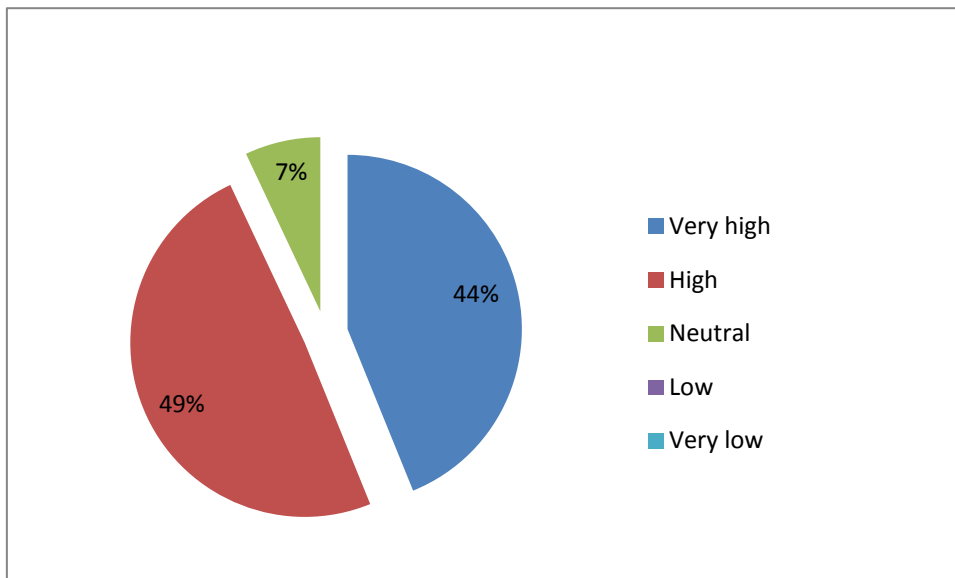
Figure 5.1: Are you willing to encourage your child to keep using the SOLE method for maths lesson - plane geometry?
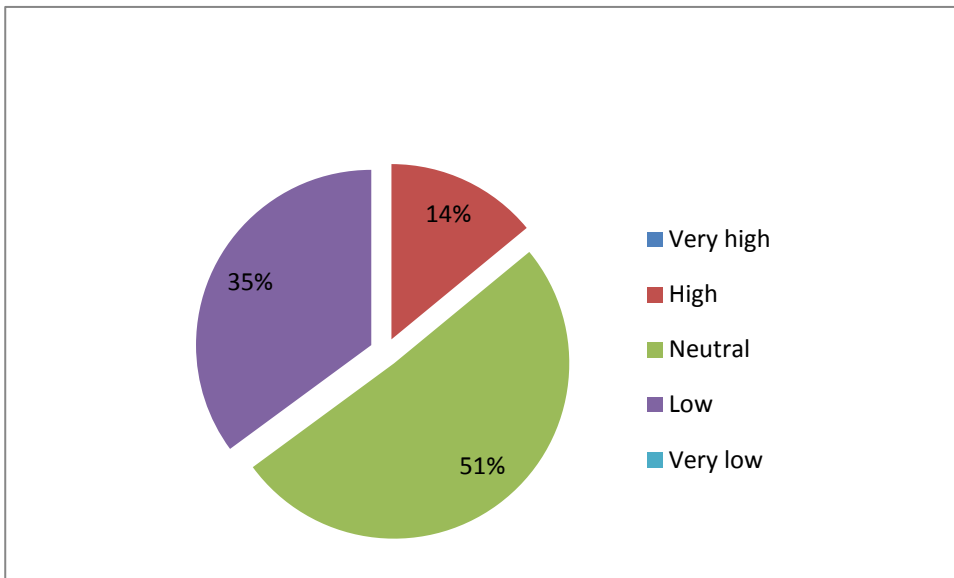
Figure 5.2: Are you willing to encourage your child to keep using the SOLE method for maths lesson - Algebra?

As can be seen from the pie chart 5.1 and 5.2, 93% of parents are willing to encourage their children to keep using the SOLE method for Plane geometry lessons and the rest of them (7%) remain neutral. However, more than 50% of parents maintain neutrality for letting their children go on learning Algebra by the SOLE method, and only 14% of them support their children to do it.
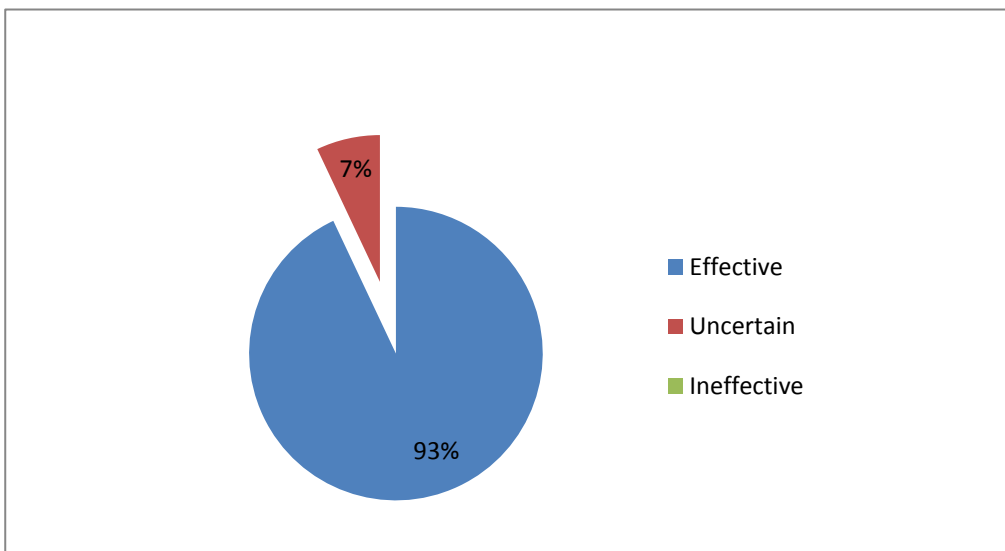
Figure 5.3: Do you think the SOLE method is an efficient learning method for math lesson-plane geometry?
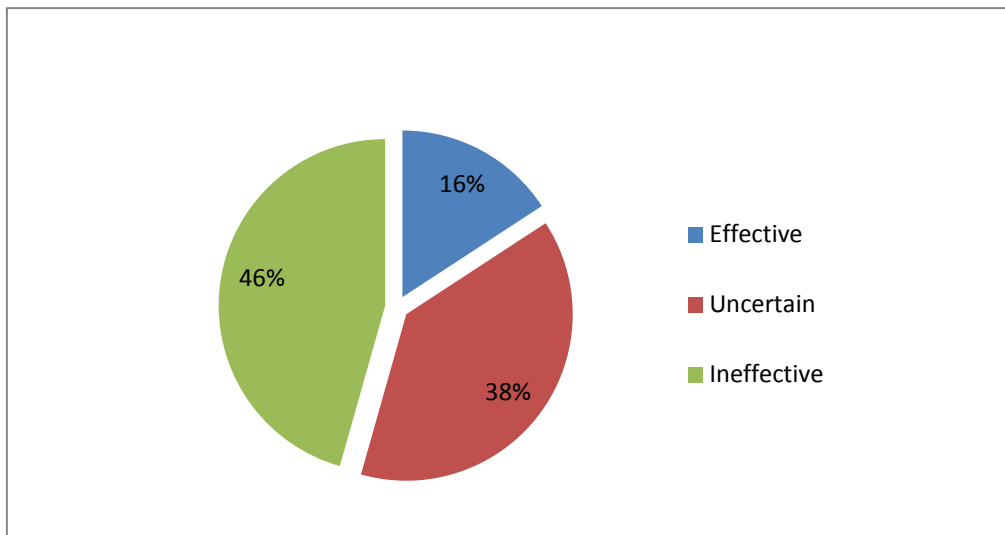
Figure 5.4: Do you think the SOLE method is an efficient learning method for maths lesson-algebra?

According to Figure 5.3 and 5.4, only 16% of parents think using the SOLE method to learn algebra is effective, and almost half of them believe that it is not a good learning method. In contrast, the combination of the SOLE and the plane geometry lessons garners a high recognition (93%) by parents.

In addition, the researcher also invited them to answer the question "How do you evaluate Self-Organised Learning with maths lesson?" The following are some of the more interesting answers:

[Positive]

"I believe the SOLE method plays a useful role in the maths lesson, at least my child can benefit from it, and his test scores increased slightly. It is a good phenomenon."

[Neutral]

"I checked my daughter's homework every evening, and also asked her to complete some additional exercises offered by me. I was delighted that she could do Plane Geometry exercises with a better performance than before, but I was not satisfied with her results on the Algebra. I hope my child can get a high score in the exam, and I would really like to help her with it as much as I can, so I invited a private tutor to help her since January. Her exam

scores were steady, but I am not sure what happened if I did not invite a tutor for her."

[Negative]

"I am not sure what the classroom atmosphere was, but after chatting with my child and Teacher B, I did not think to solve maths problems by the SOLE would be a good choice. Maybe it certainly did help in some of those Plane Geometry lessons, but when I asked my child to do some maths exercises, he always made mistakes on easy questions, and he told me the SOLE class did not help him to understand these questions timely. "

"Maths is not like history. I admit that the SOLE method is useful to improve her study interest and academic performance, but this is not easy to understand and solve all maths problems by using the Internet. I do not want my child to have her maths lesson with the SOLE method, and it is not a good substitute for traditional teaching methods."

In total, there were 12 parents expressed a positive attitude, 29 parents gave a negative attitude, and 16 parents maintain neutrality on using the SOLE in maths lessons. The researcher supposed that parents' thoughts directly or indirectly reflected the students' attitudes. Teacher B and the researcher hoped that students explain the teaching situation in the school to their parents, and communications between the teacher, student and the guardian were very important. The school and teachers always took account of parents' feedback, and only under the dual guidance of school and family, the conspicuous effectiveness of teaching and learning could be achieved.

5.5 Analysis of Homework Assignments and Test Scores

As with the history lessons described in Section 4.5, in an attempt to estimate students' learning outcomes with different teaching and learning methods in maths lessons, their performance on homework and three exams were also measured. The SOLE group and control group were analysed separately.

5.5.1 *Assessment of Homework Assignments*

(1) SOLE Group

Maths is one of the major courses for Chinese students, and it plays a decisive part in the Senior high school and College entrance examination. Students have to spend a lot of time doing many exercises after class. In the SOLE tasks, the teacher would not guide students step by step in class as usual, and students had to try to understand the basic concepts of learning contents and discover how to do the exercises. Students were required to complete a set of self-assessment exercises with the SOLE lesson's essential knowledge, and they had to complete them individually at home. Teacher B confirmed that homework was a good tool to check whether students understood all learning contents in the SOLEs.

History homework consisted of Multiple Choice and Essay questions, but there were many different types of exercises for the maths homework, such as multiple choice, gap filling, proof questions, drawing, and so on. The researcher is a non-native English speaker, and she will try to translate those complicated maths exercises into English as accurately as possible. There are some examples:

Plane geometry:

· *Which one is the axial symmetric figure?*
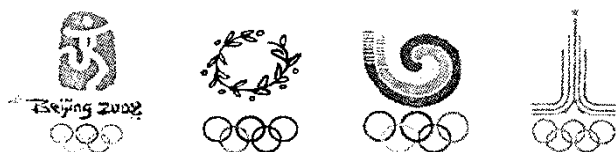
· *Prove: The base angles of an isosceles triangle are equal.*

· *Given: D is on the AB, DF and AC are crossed at E, DE=EF, and AE=CE.*

Prove: AB∥ CF

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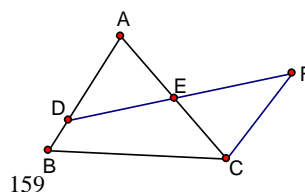
- *In this diagram, if △ ABC and △ DEF are congruent triangles, then there are ___ groups of the same line segment.*

A   D

B   E   C   F
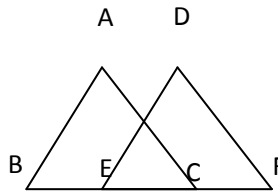
Algebra:

- *If these numbers arranged regularly: 1, 2, 4, 8, 16 ,......, then the 2005th will be( )*

  A. 2^{2005} B. 2^{2004} C. 2^{2006} D. 2^{2003}

- *Which one is true? ( )*

  A. $a-(b+c)=a-b+c$ B. $x^2-4=(x-2)^2$

  C. $(a-b)(a+c)=a^2-ab+ac-bc$ D. $(-x)^3 \div x^3 = x(x \neq 0)$

- *Simplify it first, and then evaluate it:* $[(x-y)^2+(x+y)(x-y)] \div 2x$, *x=2005，y=2004.*

- *Calculate:* $(\sqrt{3})^2 + 4 \times (-\frac{1}{2}) - 2^3 + \sqrt[3]{27}$

  $(12a^3 - 6a^2 + 3a) \div 3a - 1$

All the above examples are only the tip of the iceberg, and there were many complicated questions in their exercise book. Through the classroom observation in the SOLE class, the researcher found that if students could not understand the basic concepts of the main topics contents, faced with these questions, they really did not know where to start to solve the problems.

Compared with the control group, Teacher B was dissatisfied with the SOLE group students' homework. She always complained that students' homework results in the SOLE class did not meet her minimum standards, and she had to spend extra time to collect all wrong answers and help students solve the problems again, in order to avoid students making the same mistake in the exams. Moreover, sometimes students were asked to rework their homework carefully over the next few days, and Teacher B would offer more exercises to help them consolidate the knowledge they had learnt. No students could avoid exercise-stuffed learning methods and grade-oriented practices in China, so how to improve the accuracy of the exercises became a considerable challenge for the SOLE group.

(2) Non-SOLE Group

Students in the control group had each lesson with the same learning contents as in the SOLE group, but they could only learn about relevant maths knowledge based on their textbook. The same homework was assigned after each class, and they also completed the assignments individually. Teacher B thought that ninety-nine times out of a hundred, students could complete the homework with a high degree of accuracy, and she could provide them with some new exercises in the next step. In other words, students in the control group were moving on to new topics when students of the SOLE group were still reworking their old exercises. The learning progress of the SOLE group always lagged behind the control class, and they could not proceed at the correct pace.

5.5.2 *Analysis of the Examination Results*

As discussed before, the SOLE group of the maths lessons followed the same procedure as the history lessons. The administrative assistant of this junior high school also provided the researcher with the average scores for each class in this grade for the previous school year (July 2014) to help the researcher select a control group which was at the similar level as the SOLE class.

Table 5.4 shows that Teacher B taught three classes in Eighth-grade, and the exam result of Class (10) is closer to that of the SOLE group Class (7). Thus, we decided to select these two classes as our experimental subjects. The members of each class were the same in the year of the experiment (September 2014) as they were in the previous year (July 2014), but one student transferred to another school after November 2014 in the Class (7).

Rankings	1	2	3	4	5	6	7	8	9	10
Scores	83.27	81.06	81.03	79.50	78.30	78.23	77.85	75.30	73.25	71.50
Class	(4)	(1)	(6)	(2)	(9)	(10)	(7)	(3)	(5)	(8)
Teacher	Mr. f	Ms. d	Mr. f	B	Ms. e	B	B	Ms. e	Ms. e	Ms. g
						Control Group	SOLE Group			

Table 5.4 Final examination ranking of maths in grade 7, July 2014

Three examination results in the two semesters were recorded by the researcher personally. It is worth noting that although the researcher realised the learning effectiveness of plane geometry and algebra were very different, it could not record students' test scores of these two types of learning contents separately, because in the examinations, all knowledge they had learned would be tested in a comprehensive way. More specifically, maths teachers always guided students to solve most of the plane geometry questions by the algebra skills, and if students could not complete them with a reasonable degree of accuracy, maths teachers would not think that students had reached an acceptable level in maths.

Some examples of combining Plane Geometry and Algebra questions as follows:

· *Given: The straight line $y = x + 1$ and $y = kx + 4$ are crossed at Point $p(1, n)$,*

  Prove: (1) the value of k and n; (2) the area of the quadrangle enclosed by these two

     straight lines and two coordinate axes.

· *In the Rt△ ABC, $\angle$ C=90°, $\angle$ B=2$\angle$ A, BC= $\sqrt{3}$ cm, AB=_____cm .*

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- *What is the area of the biggest square?*

  A．a^2 B．a^2+b^2

  C．$a^2+2ab+b^2$ D．a^2+ab+b^2
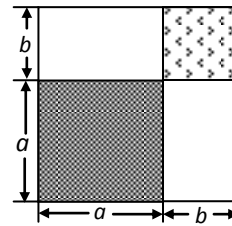
- *In this diagram，$\triangle ABC$，$\angle C=90°$，AD divide equally $\angle BAC$，BC=10cm，*

  BD=7cm，What is the distance from Point D to the straight line AB?
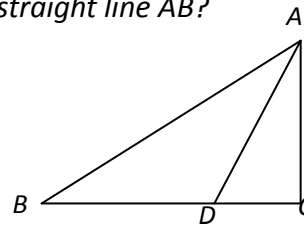
- *Known: AC$\perp$CB，DB$\perp$CB，AB$\perp$DE，AB=DE, and E is the midpoint of BC.*

  Questions: (1) If BD=6cm, then AC=_____cm.

  (2)Prove the quantitative relation between BD and BC.
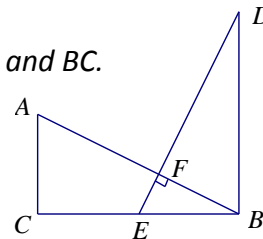
Thus, it was difficult to classify the question types in the maths exams, so the researcher only analysed the aggregate performance.

(1) Three exam results for the SOLE group

Paired Samples Statistics[a]

		Mean	N	Std. Deviation	Std. Error Mean	T	df	p
Pair 1	Maths(1)	77.2807	57	12.73319	1.68655	-1.799	56	.077
	Maths(2)	81.7895	57	13.84188	1.83340			
Pair 2	Maths(2)	81.7895	57	13.84188	1.83340	.586	56	.561
	Maths(3)	80.9825	57	10.37423	1.37410			
Pair 3	Maths(1)	77.2807	57	12.73319	1.68655	-1.742	56	.087
	Maths(3)	80.9825	57	10.37423	1.37410			

a. GROUP = SOLE Group

Figure 5.5 Three maths exam results for the SOLE class

As described in Section 4.5.2, the researcher also used the pair samples t-test to test the mean of pairwise differences of three examinations for the maths lessons (N=58 in the first exam, but one student transferred after the first exam, so N=57 automatically in the Paired Samples Statistics). The analysis result of Pair 2 indicates that although students made a little progress from the first exam (77.28, November 2014) to the third exam (80.98, May 2015), the students' performance decreased in the third exam compared with the second test (81.79, January 2015). The p-value of every paired sample is more than 0.05 (0.077, 0.561, 0.087), so it can be concluded that there is not a statistically significant difference in total scores between exam 2 and exam 1, exam 3 and exam 2 and exam 3 and exam 1.

(2) Three exam results for the control group

Paired Samples Statistics[a]

		Mean	N	Std. Deviation	Std. Error Mean	T	df	P
Pair 1	Maths(1)	77.9167	60	13.60869	1.75687	-3.206	59	.002
	Maths(2)	83.1833	60	16.05868	2.07317			
Pair 2	Maths(2)	83.1833	60	16.05868	2.07317	-.036	59	.971
	Maths(3)	83.2667	60	11.32998	1.46269			
Pair 3	Maths(1)	77.9167	60	13.60869	1.75687	-2.554	59	.013
	Maths(3)	83.2667	60	11.32998	1.46269			

a. GROUP = Control Group

Figure 5.6 Three maths exam results for the control class

Figure 5.6 indicates that each time the mean scores for the maths test are higher than the previous test (77.92, 83.18, and 83.27), and the p-value of Pair 1 and Pair 3 are less than 0.05 (0.002, 0.013). Thus, it indicates that there is a statistically significant difference in total scores between exam 2 and exam 1, exam 3 and exam 2 and exam 3 and exam 1.

(3) Comparison of the exam results for the SOLE group and control group

Group Statistics								
Group		N	Mean	Std. Deviation	Std. Error Mean	T	df	p
Maths(1)	SOLE	58	77.3276	12.62605	1.65788	-.244	116	.808
	Control	60	77.9167	13.60869	1.75687			
Maths(2)	SOLE	57	81.7895	13.84188	1.83340	-.502	115	.617
	Control	60	83.1833	16.05868	2.07317			
Maths(3)	SOLE	57	80.9825	10.37423	1.37410	-1.136	115	.258
	Control	60	83.2667	11.32998	1.46269			

Figure 5.7 Comparison of maths exam results for the two groups
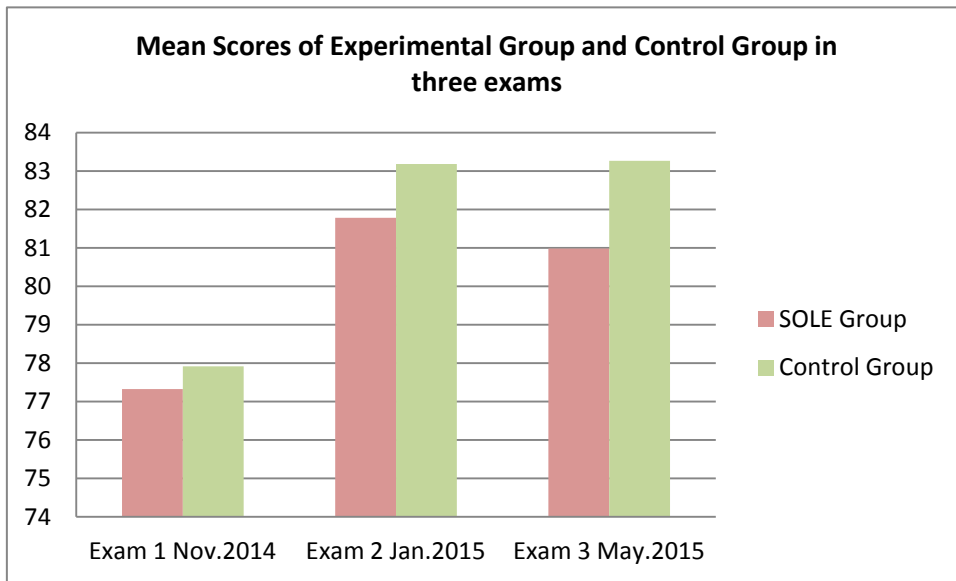
Figure 5.8 Mean overall scores for two groups in three maths exams

These results can be seen clearly in Figures 5.7 and 5.8. In the all three examinations, students in the SOLE group only make progress in the second exam. However, they get a lower mean score than control group all the time.

The exam results for November 2014, January 2015, and May 2015 for all 10 classes in eighth-grade were then compared.

Rankings	1	2	3	4	5	6	7	8	9	10
Scores	83.50	83.13	81.90	79.55	77.92	77.85	77.33	74.29	73.85	71.17
Class	(4)	(1)	(6)	(2)	(10)	(9)	(7)	(3)	(5)	(8)
Teacher	Mr. f	Ms. d	Mr. f	B	B	Ms. e	B	Ms. e	Ms. e	Ms. g
					Control Group		SOLE Group			

Table 5.5: Mid-term examination ranking of maths in grade 8, November 2014

Rankings	1	2	3	4	5	6	7	8	9	10
Scores	87.54	86.35	84.20	83.18	82.75	81.79	81.75	79.00	77.42	77.15
Class	(1)	(4)	(6)	(10)	(2)	(7)	(9)	(5)	(3)	(8)
Teacher	Ms. d	Mr. f	Mr. f	B	B	B	Ms. e	Ms. e	Ms. e	Ms. g
				Control Group		SOLE Group				

Table 5.6: Final examination ranking of maths in grade 8, January 2015

Rankings	1	2	3	4	5	6	7	8	9	10
Scores	87.15	86.05	85.78	84.20	83.27	82.15	81.30	80.98	78.75	74.30
Class	(4)	(1)	(6)	(2)	(10)	(9)	(3)	(7)	(5)	(8)
Teacher	Mr. f	Ms. d	Mr. f	B	B	Ms. e	Ms. e	B	Ms. e	Ms. g
					Control Group			SOLE Group		

Table 5.7: Mid-term examination ranking of maths in grade 8, May 2015

According to Table 5.5, 5.6, and 5.7, during this experiment, the class rank of the control group is always ahead of the SOLE Group in three exams. Along with Table 5.4, the control group is ranked No. 6, No5, No.4, and No.5, and the SOLE group is ranked No.7, No.7, No.6, and No. 8. Overall, there is not a significant change for either of these two groups and their levels remained steady on the whole. However, during the experiment, the rank of the SOLE group decreased from No.7 to No.8, but control group increased from No.6 to No.5. These results show that compared with the conventional learning method, using the SOLE to learn Eighth-grade maths contents in China, in this Junior high school, would not help students to improve their academic performance within eight months.

According to the examination schedule arranged by the provincial education departments, when students took the third set of exams in the May of 2015, we were only left two plane geometry lessons and two algebra lessons, and Teacher B still had to offer her help more or less when the students did their algebra tasks in the SOLEs. We did not set another examination to test their results again, and just kept observing and recording their classroom performance, collecting diary feedback, and noting the homework results. Teacher B and the researcher believed that above three exams could clearly show the comparison results between these two groups.

5.6 Four Examples Lessons

20 maths lessons were observed in the SOLE class. In Chapter 4, the researcher had described three history lesson observations in detail, included the first lesson, the tenth lesson, and the last lesson. However, considering the course design and learning arrangements of the maths lessons, the researcher selected four lessons to make a detailed description here, included the first and last plane geometry lessons, and the first and last algebra lessons.

5.6.1 *Report 1—First Plane Geometry course observation*

Date: 08.10.2014

Main Discussion Topic: Triangle and Equilateral triangle

Groups: 58 students, Self-organised into groups, 4-6 students every group;

Number of laptops: 56 prepared, 12 used;

In Section 4.6.1, the researcher had given a detailed explanation about how facilities were prepared in the SOLEs, and it will not be stated again here. When we began to conduct the first maths lesson in the SOLE, students had completed two history lessons with the SOLE method. The main reason was, in the early communication with Teacher B, two of us found it was a little hard to design specific maths problems based on the teaching programme to allow students to solve them using the internet resources. Finally, we decided to start with the plane geometry lessons first.

Questions posed by Teacher B:

Teacher B took about two minutes to show a slide with six questions based on her lesson plans and course contents, and told her students what she expect them to complete before the class ended.

1. What are the characterizations of the Equilateral Triangle?
2. What are the similarities and differences between an equilateral triangle and an isosceles triangle?
3. Summarize the properties and determination of the Equilateral Triangle.
4. What live items are equilateral triangles in our daily life?
5. In this diagram, known AD=BE=CF, what shape is $\triangle$DEF?, Why?

6. In this diagram, △ABC and △CDE are equilateral triangles．BE and AC are crossed at F，AD and CE are crossed at H，

(1) Prove：△BCE≅△ACD；

(2) Prove：CF=CH；

(3) What shape is △CFH? Why?

Classroom observations:

Teacher B intervened for twice due to students asking for help. The researcher remained silent and only walked around the classroom observing students' work and taking some notes.

(1) Positive aspects:

Students were interested in using the internet resources to help them solve problems 1-4, and they found out many different triangle pictures to help them summarise the basic concepts of the equilateral triangle. The noise level in the classroom ranged from chaotic to acceptable gradually, because all groups were involved in a heated discussion on Question 1-5, especially on Question 4, although most of them were stuck on the Question 6 and did not know what to do. In this class the researcher could hear students tried to exchange their answers with other groups. The researcher walked around them and glanced at their notes, and found most of them could take clear note of those necessary knowledge points. Teacher B also said students created a good class atmosphere by themselves.

(2) Negative aspects:

Teacher B told the researcher that in the conventional class, she could guide students to solve some problems like Question 5 and 6, but in the SOLE class, students had to complete it without teacher's help. We noticed that students felt anxiety when they moved to the final question, they changed the group again and again, and maybe they wanted to find a 'smart' guy who could tell them what was going to do next. Teacher B interrupted them twice and

told them they could try to find some similar examples from the Internet to study how to solve this kind of exercises, and they should combine previous questions with Question 5 and 6 together. Before the class was over, Teacher B demonstrated how to prove Question 5 and 6 step by step on the blackboard.

Feedback:

The researcher referred to students' diary forms, the teacher's Reflection Form and audio recording, and students' homework to investigate the effectiveness of the SOLE learning method with the maths lessons. Students thought that using the SOLE method to acquire Plane Geometry knowledge was an attractive activity, but they could not solve all questions within the required time, and most of them hoped that Teacher B could spend more time to guide them to complete those exercises. At this point, the researcher believed that students were biased towards the conventional teaching method. On the other hand, Teacher B claimed that she was not satisfied with the results of this lesson, because her students in the control group had enough time to complete another new three exercises like Question 5 and 6 under her guidance in the class. However, she also admitted that students in the SOLE group had a better performance on Question 1-4 than the control group.

5.6.2 *Report 2—Last Plane Geometry course observation*

Date: 14.05.2015

Main Discussion Topic: Area and Perimeter of a Parallelogram
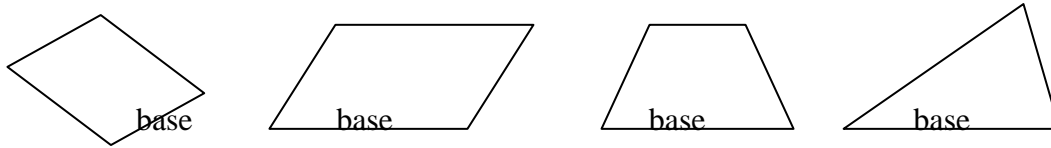
Groups: 57 students; Self-organised into groups, 4-6 students every group;

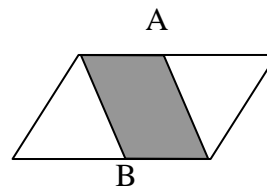**Number of laptops:** 15 prepared, 11 used;

Questions posed by Teacher B:

Teacher B took about two minutes to show a slide with these six questions based on her lesson plans and course contents at the start of the class.

1. What is the area formula of a Parallelogram?

2. How to calculate the perimeter of a Parallelogram?

3. According to the given base side to draw the 'height' of following diagrams:

4. There is a vegetable garden is a parallelogram, the base side = 100m, height=50m, the yields is 125 tons per hectare. How many tons of the total yields in this garden?

5. The area of this diagram is 64 square meter, A and B are the midpoints of these two sides. Calculate the area of the dash area.

6. Known: the perimeter of a Parallelogram ABCD is 52, drawn the height $DE \perp AB$, $DF \perp BC$, E and F are foots of perpendicular. Given DE=5, DF=8, Calculate: BE+BF=?

Classroom observations:

In this lesson, Teacher B and the researcher intervene in their discussions for two times. The rest of the time we just walked around the room to observe students activities.

(1) Positive aspects:

Compared with the first plane geometry lesson, in this lesson students were not only required to understand some basic maths concepts of different shapes, but they had to know how to draw a precise diagram according to the given conditions, how to calculate the area and parallelogram of a geometric figure, and how to analyse and solve practical problems with the relevant Geometry concepts. In accordance with the teaching programme, we conducted 9 Plane Geometry lessons, and students had positive attitudes on using the Internet to understand basic concepts of geometric figures. For example, in today's lesson, the teacher asked students to think about how to calculate the area and perimeter of a Parallelogram, most of the students discovered some dynamic pictures and animations which showed the process

of the derivation of formulas, and that helped them understand the complex concepts in an easier way.

(2) Negative aspects:

Compared with the non-SOLE group, students in the SOLE group did not learn more, and the biggest issue was that students did not have enough time to complete all the learning tasks in the class. If Teacher B did not offer them any help, they would not understand all important knowledge by themselves. In addition, in the previous lessons, students found out an Online Calculator which could solve the geometric problems automatically. Online tools which students operated in the SOLEs were the Chinese version, and in order to let the reader be easier to understand how this kind of Calculator operated, here the researcher uses a similar English Online Calculator to explain it. As shown in Figure 5.9, this tool can 'calculate certain variables of a parallelogram depending on the inputs provided. Calculations include side lengths, corner angles, diagonals, height, perimeter and area of parallelograms' (Source: https://www.calculatorsoup.com/). Students used this kind of online tools to do some exercises, and they did not need to understand what the processes to solve a maths problem were, and they would get a correct answer directly. Some excellent students were willing to analyse the answers and discuss how to get this result step by step, but for some others, they copied the answer directly, and Teacher B did not think this was a good phenomenon because they had to solve problems step by step in the examinations.

Parallelogram Shape

a = sides a lengths
b = sides b lengths (base)
p and q diagonal lengths
h = height
A, B, C, D = corner angles
K = area
P = perimeter
π = pi = 3.14159

Figure 5.9 Online Parallelogram Calculator

Feedback:

Teacher B completed her teaching plans for this lesson. All of the important and difficult contents were mastered by students themselves, although Teacher B and the researcher intervened in their discussions for two times. Students enjoyed acquiring knowledge by the live and exciting discussion in a SOLE. However, after Teacher B corrected their homework, she insisted that students in the non-SOLE group had a better achievement. The researcher discussed this issue with all other maths teachers in this grade, and they speculated that online resources could help students improve their creative thinking, but considering the test-oriented education system in China, students should spend more time to do more maths exercises offline.

5.6.3 *Report 3 —First Algebra course observation*

Date: 18.11.2014

Main Discussion Topic: Multiplication of Integral Expression

Groups: 57 students; Self-organised into groups, 4-6 students every group;

Number of laptops: 37 prepared, 11 used;

Questions posed by Teacher B:

Teacher B took one minute to show a slide with the following questions to students before they began the SOLE tasks.

1. What is the rule of multiplying exponents with the same base?

2. What is Factorization?

3. Which one is correct?

    A. $a^3 \cdot a^2 = a^6$ B. $b^4 \div b^4 = 1$ C. $x^5 + x^5 = x^{10}$ D. $y^7 \cdot y = y^8$

4. If $a^m \cdot a^3 = a^5$,   m=?

5. If $a = 3, b = -\dfrac{1}{3}$, $(a+b)(a-b)+(a+b)^2 = ?$

6. Calculate: $\left(2a^2 - \dfrac{2}{3}a - \dfrac{4}{9}\right) \cdot (-9a)$; $(-3ab)(-a^2c)^2 \cdot 6ab(c^2)^3$;

$$\left[x(x^2y^2 - xy) - y(x^2 - x^3y)\right] \div 3x^2y;$$

$$(5x + 7y - 3)(5x + 3 - 7y);   (2x^3)(-5xy^2);$$

$$\left(-\dfrac{3}{2}x^2yz^3\right) \cdot \left(-\dfrac{4}{3}xz^3\right) \cdot \left(\dfrac{1}{3}xy^2z\right)$$

7. Calculate this system of inequalities:

$$\begin{cases} x(2x-5) > 2x^2 - 3x - 4 \\ (x+1)(x+3) + 8x > (x+5)(x-5) - 2 \end{cases}$$

Classroom observations:

In this lesson, students from different groups always raised hands asking for help. Teacher B and the researcher intervened in their SOLE tasks twelve times.

(1) Positive aspects:

Before this lesson, Teacher B told the researcher that she did not make sure if students could summarise Question 1 and 2 correctly by themselves. According to her teaching experiences, students always made a mistake in this part, and some students could not understand it clearly under the conventional teaching method. In the SOLE class, most of the groups spent around 15 minutes on searching for the relevant information and examples to solve these two problems. After that, Teacher B interrupted them, and she would like to confirm if students got a correct conclusion on Question 1 and 2, because all of the other questions had to complete based on these two basic questions. Three-quarters of groups took a detailed note to record it, and the rest of students found out the explanation of these two questions, but they could not understand what it means. Teacher B suggested them change their groups if they wish, and communicated with other students to solve this problem. Then, they moved to next questions. Some of the students tried to calculate these questions based on the Formulas and Rules they summarised before, and some of them who did not have ideas kept using the Internet to search for similar examples. The class maintained a positive and active state.

(2) Negative aspects:

Due to the particularity of the Algebra, students were often confused about some maths expressions online, so they had to spend a lot of time dealing with this 'inaccurate information'. For example, we could edit a correct maths expression by the Equation Editor in Microsoft Word, but some maths symbols could not be presented correctly on the website, such as:

$a^m * a^n = a^{(m+n)}$ is presented online as   a^m*a^n=a^(m+n);

$(a^m)^n = a^{(m*n)}$ is presented online as   （a^m）^n=a^(m×n);

Thus, it was a waste of time to deal with similar problems if the teacher did not give them a lucid and timely explanation.

On the other hand, Teacher B hoped students could solve their maths problems as much as possible. However, we noticed that when some students found an algebra example online, they always just looked at the page and did not do anything. It seemed these students mistakenly thought that they had got the skills to solve the algebra problems, but in fact, they always copied the correct answers from other groups directly, rather than solved them by themselves.

Feedback:

Teacher B thought the first algebra lesson was not too bad, but compared to the previous geometry lessons in the SOLE, students were less active in this class. Students gave the researcher their diary feedback and most of them wrote down that they were preferred to learn algebra contents with teacher together. Students thought they spent too much time on summarising the formulas and those essential concepts. If they were in the conventional class, Teacher B could guide them complete this part in 10 minutes, and they could save time to do more exercises. Moreover, one-third students said they faced difficulties when they were completing the homework, and they did not have a clear thinking on how to calculate those questions. They needed extra help from Teacher B after the class.

5.6.4 *Report 4—Last Algebra Lesson course observation*

Date: 27.05.2015

Main Discussion Topic: Application of Linear function
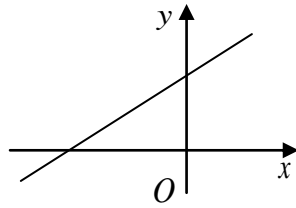
Groups: 57 students; Self-organised into groups, 4-6 students every group;

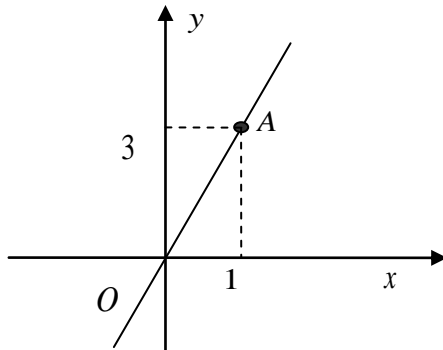**Number of laptops:** 15 prepared, 11 used;

Questions posed by Teacher B:

Teacher B took one minute to show a slide with the following questions to students before they began the SOLE tasks.

1. Known: As is shown in the graph, if $y = (a-1)x + b$, what is the range of a?

2. What is the functional analytic formula of this direct proportion function?

3. It is a directly proportional relation between y and x+1, when x=2, then y=1;

Calculate, When x=-3, y = _____

It was a little difficult to translate Question 4 and Question 5 into English here. In brief, those two calculation questions were more complicated than above three questions, and they were also relevant to the linear function.

Classroom observations:

Students felt more and more helpless in SOLEs since they began to learn Fractions, and they always confused what they should do online on these questions. Teacher B and the researcher tried to find some ways to guide them complete their SOLE tasks without our intervention, but when they tried to solve problems, they always longed for Teacher B's help. Teacher B said the progress of SOLE group lagged behind the control group, and students were not excited about the algebra lessons with the SOLEs. Students had to spend at least 10 minutes to find out some internet resources to help them understand and further solve only ONE problem. However, in the conventional class, students could answer around TWO or more questions at the same time. Both Teacher B and students in the SOLE group were not satisfied

with their performance in the algebra lessons.

Feedback:

Teacher B thought that learning in the SOLEs was a pleasant experience for her, especially in the plane geometry lessons. However, it was also a huge challenge for all of them. She believed that it was really difficult to master all current teaching contents using online resources for eighth-grade students, and after we finished the whole experiment, she would stop using this SOLE method and bring them back to the conventional teaching environment. Students got an excellent performance in history lessons with the SOLE method, but they did not have the same experience in maths lessons. At least we confirmed that although students could understand basic maths concepts online, this situation still could not help them solve all complex maths problems in the SOLEs.

5.7 Chapter Summary

This chapter discussed the application of the SOLE method in the maths lessons. The feedback from students and Teacher B showed that they really enjoyed doing geometry tasks much more than algebra tasks in the SOLEs. Based on three examination results, it can be concluded that compared with the control group, students do not make significant progress in maths lessons using self-organised learning with the Internet.

Chapter 6. Discussion of Research Findings

6.1 Introduction

The previous chapters have identified the research gaps the researcher intends to cover (Chapter 2) and the research questions the researcher intends to answer (Chapter 3) in this study, and Chapter 2 covered the theory of learning (constructivism) underpinning the use of SOLEs. Drawing on data collected from this SOLE studies, Chapter 4 and Chapter 5 analysed the learning process and learning outcomes of history and maths lessons in the SOLEs, and analysed what was similar and what was different about the use of SOLEs in those subjects.

This chapter moves on to examine the results in relation to the research gaps and research questions, and more broadly, in relation to existing studies. Section 6.2 brings together the results to try to answer three research questions, and the discussion focuses on learning processes, learning outcomes, the roles and attitudes of different participants for the SOLEs. Section 6.3 explains the importance of using technology in learning. Section 6.4 discusses the concept of 'framing' and 'constructivism' in the SOLEs, which could provide a guidance and theoretical support for the future research.

6.2 Research Findings on Research Questions

The aim of this study was to investigate the following three main research questions and related sub-questions:

1). How effective is a SOLE method within school curricula for different subjects?

a) How effectively do SOLE and non-SOLE groups perform in different subjects?

b) Are there any differences in homework and exam performance for different subjects?

c) Are there any other learning outcomes other than those measured by exam performance?

2). What is the effect of the roles participants play in a SOLE?

a) What roles do teachers, students and parents play in a SOLE?

b) How do teachers, students and parents adapt to their roles?

c) How effectively do students work in their new roles?

3). What are the attitudes of teachers, students and parents towards a SOLE?

a) What are their attitudes before the introduction of a SOLE?

b) What changes in attitudes are there based on their experience of a SOLE?

c) What are the reasons for any change in attitudes?

6.2.1 *The Effectiveness of a SOLE within School Curricula*

In Section 2.6, the researcher summarised the outcomes and learner characteristics for effective learning. According to Watkins et al. (2002:4), learning is an activity of construction, handled with others, and driven by learner's agency. Effective learning is all of these at their best, plus the monitoring and review of whether approaches and strategies are proving effective for the particular goals and context. To answer research question one, first, we need to discuss the results of classroom observation of the SOLE and non-SOLE groups for the two subjects. For the non-SOLE group, Teachers A and B taught as they normally did, with the learning activities they normally used, i.e. the students did not work in groups, there was no self-organised discussion, and no use of the Internet in class. In history classes, Teacher A summarised all the basic points the students were expected to learn on the blackboard, and students were expected to read the textbook and then take some notes. Meanwhile, the students in the non-SOLE group were asked to think about and answer questions independently, rather than in a group, and as a result, if particular individuals did not stay focussed on answering a question, there was no reminder from peers to do so, and nor was the teacher able to check how focussed each student was.

In maths classes, students were presented with different geometric figures in the textbook, and Teacher B also drew these geometric figures herself on the blackboard in order to explain more clearly the relevant properties and theorems, it occupied most of the classroom time. In

the algebra lessons, Teacher B first explained some basic concepts and then asked students to work out math problems on paper individually. Teacher B could discuss the correct answers with the whole class, so if a student has a problem with the maths questions, he or she was able to seek immediate help from the teacher.

As mentioned in Section 2.4, curriculum guides and materials used in China's education systems are required to bear an approval from a national or system-level authority, teachers and students in China have almost no flexibility in deciding what is taught and learned (Li and Ginsburg, 2006). In this study, for the non-SOLE group, Teacher A and Teacher B simply followed the instructional requirements and suggestions to teach each lesson. According to the classroom observations, both Teacher A and Teacher B could basically complete their teaching tasks followed the syllabus, and students accepted knowledge passively in this pattern.

For the SOLE group, Teachers A and Teacher B designed the SOLE questions based on the same instructional requirements as the non-SOLE group. The SOLE created a student-centred classroom, and the teachers were mainly in the class to encourage students to work as a team to solve questions using the Internet. In history classes, Teacher A posed questions based on her lesson plans and course content, then students self-organised into groups and did their SOLE tasks. In the first few classes, a minority of students did not do the task they were asked to do, and they browsed the web for information that was not relevant to the SOLE tasks, but with their deep understanding of the SOLE, most of the students could keep their concentration and complete their group tasks properly. The students were excited to discuss and find answers to history problems using resources they found on the topic on the Internet, and they were very happy if they could find interesting reading material or videos faster than other groups. Students were hungry for Teacher A's praise, and they would be in a happy mood during the whole class if they were praised. Students in the SOLE group master more knowledge that is not learned in their textbooks by using rich internet resources.

However, students had an ambivalent attitude toward the math lessons in the SOLEs. They were more interested in solving plane geometry problems than the algebra problems in the SOLEs, because they were motivated by the interesting animations or videos and many dynamic graphics they found to help them quickly understand the relevant concepts for each geometric shape. Compared with the history, maths has more abstract and theoretical characteristics, and most of the students did not find that SOLEs offered a more effective way of learning algebra. Most of the time, students could not solve algebra questions without the help from Teacher B. The students thought that the internet resources always complicated some simple concepts, so many students were unable to benefit from them. Thus, students performed more actively in the history class with the SOLE. Students also enjoyed doing geometry tasks in a SOLE, but they found that it was easier to learn algebra in non-SOLE classes.

For both history classes and maths classes, students had to work in a group in the SOLEs, and teachers walked around the class or stood in the corner to observe their activities. Thus, perhaps the teacher could not identify an individual's problems at this stage, and then had to check students' homework after class to find out whether they had learned what they were expected to, especially in the maths class. Of course, teachers also needed to check student's learning outcomes in the non-SOLE group in the same way, but in a traditional class, students could follow teacher's guidance step by step, so it was easier to deal with their problems in non-SOLE class.

Secondly, Teacher A and the researcher compared students' homework from the SOLE group and the non-SOLE group, and the researcher had summarised the assessment of homework assignments for history classes (see Section 4.5.1) and maths classes (see Section 5.5.1). For history classes, we found that students in the non-SOLE group could get a high accuracy on the multiple choice questions about the basic history concepts, but when they answered essay questions, most of the students could only answer those questions for which correct answers

could be copied directly from the textbook. Students in the SOLE group also had a good performance on the multiple choice questions, and in the course of time, most of the students improved their ability to structure an essay answer with clear logical thinking and accurate terms. Students in the SOLE group gradually understood how to describe a historical event with the keywords, rather than wrote down all the information they found online. The only issue is, the students could browse many discussions on the historical topics online, and so may encounter and perhaps absorb politically sensitive issues which teachers did not encourage students to discuss. Although Teacher A did not say so directly, she assumed that students could not get a high mark in the exam if they expressed ideas that did not conform to mainstream social values.

There were many different types of exercises for the maths homework, such as multiple choice, gap filling, proof questions, drawing, and so on. Teacher B found that students in the non-SOLE group could complete the homework with a high degree of accuracy, and she could provide them with some new exercises in the next step. However, Teacher B was less satisfied with students' algebra homework for the SOLE group. She always complained that students' homework results in the SOLE class did not meet her minimum standards, and she had to spend extra time to identify the mistakes the students had made with their algebra homework and help students solve the problems again, in order to avoid students making the same mistake in the exams. Moreover, sometimes students were asked to rework their homework carefully over the next few days. That is, students in the non-SOLE group were able to move on to the next exercises while students of the SOLE group reworked their old exercises. The learning progress of the SOLE group always lagged behind the non-SOLE class, and they could not proceed at the required pace. Under the exam-oriented education system, almost all students had to accept exercise-stuffed learning methods and grade-oriented practices, so how to improve the accuracy of the exercises became a considerable challenge for the SOLE group.

Thirdly, it is necessary to compare three exam results for the SOLE group and non-SOLE group. For history classes, the researcher and Teacher A found students in the SOLE group made useful progress and got higher scores in the second and third exams than the non-SOLE group, and students in the SOLE group had a better performance on all kinds of essay questions in the exams (see Section 4.5.2). The rank of the SOLE group in comparison to other classes in their year increased from No.9 to No.1 within nine months. From these results, it seems likely that using the SOLE to learn history was more effective in helping students to enhance their academic performance than conventional teaching methods. For maths classes, the researcher and Teacher B found students in the SOLE group got a lower mean score than non-SOLE group in each exam, and the class ranks of the non-SOLE group were always ahead of the SOLE group in all three exams (see Section 5.5.2). Even more, the rank of the SOLE group declined in relation to other groups at the same grade level during the research period. These findings show that compared with the conventional learning method, using the SOLE to learn eighth-grade maths in China, in this instance and this Junior high school, did not help students to improve their academic performance within nine months.

Fourthly, it is worth considering whether there are any learning outcomes other than those measured by exam results. The SOLEs potentially provide a useful way for learners to actively construct knowledge by using their existing perspectives and acquiring new knowledge, and sometimes they were able to correct mistakes or mis-conceptions by themselves. Especially in history lessons, some of the students even used critical thinking skills to check and verify the authenticity of information online. These students understood how to set goals before doing a SOLE task, and they were able to monitor their own performance in a SOLE (see Section 4.3.1). After each SOLE class, students also evaluated and reflected on their experiences using the diary form, and made adjustments to next SOLE class if necessary. Thus, the researcher tends to believe that the SOLE approach could improve a learner's thinking skills. Students were also able to master the searching and summarising skills in a SOLE, because they gradually understood how to find, select,

organise, and present the information online to explain a question.

In Section 2.3.4, the researcher reviewed the relevant explanation on collaborative and cooperative learning. Cooperative and collaborative group work may lead to improvements not just in the group, but also in individual performance. In this SOLE study, for both history group and maths group, students had to complete their SOLE tasks within a group, so they could develop their communication skills, interpersonal skills and intrapersonal skills while they are solving problems. When the teacher invited students to share their discoveries, the researcher found that over time most of them developed excellent presentation skills to explain their group findings in a clear and coherent way. Paradowski (2014:9) argues that groups often mean that 'one or two people do most of the work while others are freeloading', so group work is not always the most effective approach. However, in this SOLE study, students had good cooperation in the class. The researcher invited students to evaluate their group members via diary forms, it seems likely that most students understand how to manage their relationships in a group, and they could perform their respective duties in the SOLEs. Above all, although learners were asked to complete the SOLE tasks in a group, the skills they developed and mastered may be helpful to students' individual development to some extent. As active learners, they were able to determine what and how would learn. All of these skills could help students develop as a lifelong learner.

In general, in this SOLE study, students meet the definition of the effective learners from Watkins et al. (2002:5), and they are active and strategic, they are skilled in cooperation and creating knowledge with others, they are able to develop goals and plans, and they monitor their own learning. The above observations collectively demonstrate that a majority of students could solve history questions and geometry problems without teacher's help, but they were in a negative situation if the maths teacher did not provide an intervention to help them solve the algebra problems.

6.2.2 *Participants' Roles within a SOLE*

To answer the question 'what is the effect of the roles participants play in a SOLE', we must consider what roles participants play in a SOLE, and how they adapt to their new roles. A SOLE is an approach to learning in which students use an Internet-connected computer to solve problems by working collaboratively in groups they have chosen themselves, with minimal mediator intervention. We have reviewed the role of a mediator within SOLEs in Section 2.2.4, and we know the mediator in a SOLE can encourage learners in a friendly manner to complete their tasks. In this SOLE study, Teacher A and Teacher B are the main mediators in the classroom, and occasionally, as a classroom observer, the researcher also played a role of mediator when needed.

Section 2.2.4 summarised some teachers' roles in the traditional teaching in China, such as knowledge provider, nurturer, devotee, instructor, prompter, culture transmitter, authority, interest arouser, and co-worker (Cui and Liu, 2009;Wan et al., 2011). In this SOLE study, before a conventional class, teachers had to follow the Chinese National Curriculum Guidelines to prepare and design the lessons in advance, and similarly, before each SOLE lesson, teachers also needed to prepare the same questions which were asked in the conventional class, and thought about what they expected students to try to achieve, so the teacher was a task designer and an organiser of learning activities. Moreover, after both SOLE and non-SOLE classes, teachers were expected to evaluate and correct students' homework to ensure that each student was aware of their strengths and weaknesses in relation to the expected learning outcomes.

As the researcher introduced in Section 4.3.3 and 5.3.3, in the non-SOLE class, teachers had to control the direction of lessons, but in the SOLE class, students had more opportunities for group learning, and teacher should ask students to control the pace of learning and allow them to make mistakes. Teachers were no longer the centre of attention as the dispenser of information, and they only walked around the classroom to observe students' activities and

provided suggestions for students' activity. Teachers did not need to transfer knowledge to students and tell them right answers directly via the blackboard or, in schools with good facilities, slides. They reduced their presence and then became a friendly spectator to encourage students to find answers themselves. Sometimes teachers played the role of a consultant, such as in the first few history lessons when students did not know how to use the right keywords to find answers. The teacher then suggested resources that might be used, and this was the situation in most of the algebra lessons. When reviewing the SOLE class of the day, the teacher invited any students to share their answers and encouraged debate, and she also asked participants to review their SOLE experience and offered suggestions to help them work more effectively next time. Given the above, learning in a SOLE is overturning the traditional teaching pattern, so the traditional roles of the teacher also change with this situation. Teacher A and B play their new roles in the SOLEs. They are no longer the knowledge provider, culture transmitter, devotee and authority, and they are becoming a mediator, facilitator, and friendly spectator in a SOLE.

In Section 2.3.4, the researcher reviewed the role of students in the traditional education in China. Various academics have concluded that Chinese students tend to be passive learners who seldom ask questions in class and they depend more on teachers for information and reply more in the use of rote learning and memorising (Murphy, 1987; Ballad and Clanchy, 1991; Chan, 1999). Xiao (2006) appears to indicate that Chinese students prefer a teacher-centred class and expect teachers to be well prepared for lessons. Some academics believed that Confucian ethic could offer an explanation why students in class seldom asked questions (Murphy, 1987; Chan, 1999; Bush and Qiang, 2000; Wong, 2004; Raymond and Choon (2017). In this study, for both history and maths classes in the non-SOLE group, students were required to maintain silence unless they encountered problems or answered the teacher's questions. As introduced in Section 4.3.2 and 5.3.2, most of the students were of poor initiative and passive in learning, they only needed to listen to what the teacher stated, and jot down the main points on a notebook. Students in the non-SOLE group only had access

to knowledge via textbook content, via the teacher's language, and via the summarised information which was written on the blackboard. Therefore, students were not expected to play an active role in the lesson, and they were viewed as passive receivers of knowledge.

Paradowski (2014:8) and Harmer (2014) also tend to suggest that the intervention from a teacher is crucial and necessary in the classroom, and Paradowski (2014) argues that students are unlikely to get far if a teacher leaves them to follow their interests because knowledge requires competent scaffolding. However, the students' role in this study was changed (see Section 4.3.1 and 5.3.1). Students in the SOLEs were required to work collaboratively. They no longer passively accepted knowledge by a teacher, textbook, or blackboard. When students used Internet resources as a tool for interacting with others, they were in an active position. That is, teachers were no longer considered as experts unless learners turned to the teacher for guidance, and knowledge was constructed by students themselves in a group. Faced with the questions posed by the teacher, students were actively thinking about what to search for, how to generate, and how to display answers. The learning process with a SOLE guided the students to define their goals, made their decisions, and evaluated their progress and outcomes. Taken together, in the SOLEs, students are no longer the passive receivers of knowledge. They become an active constructor of knowledge, an autonomous learner and a collaborative participant, and they begin to build up active and probe learning methods.

Parents' roles in this research are also relevant as, although they were not involved in students' learning process in the classroom, they were also one of the most import participants when deciding whether to allow students to use SOLEs in the school (see Section 3.4.2). As introduced in Section 2.3.1, for most Chinese parents, the aim of education is nothing more than merely helping their children to pass examinations. Mitra and Dangwal (2010) suggest that a 'grandparent' model of encouragement is good for children, which means the mediator should use gentle encouragement and phrases such as '*I wish I could do that*!', '*I could never have understood that*' or '*please explain this in simple words to me, I am very scared of*

science'. (Mitra and Dangwal, 2010:680), which will motivate the children to learn and share their joy of achievement with the mediator. However, As Kirkpatrick and Zang (2011:38) indicated, in China, only top-performing students in high-stakes tests may enrol in prestigious universities, get recruited for satisfactory jobs, and enjoy opportunities that are off-limits to lower scoring students, so Chinese parents do put too many expectations and pressure on children (Chen, 2016). The parents see their role as monitoring their children to ensure they complete homework earnestly and urging children to learn all the time. In this study, according to the questionnaire feedback (see Section 4.4.3 and 5.4.3), it seems likely that most parents actively adjusted their roles and gradually became a friendly mediator to encourage children to learn history and geometry in the SOLEs, even encouraged their children to use the Internet at home for their studies. Of course, they changed their roles because they knew their children enjoyed doing tasks in the SOLEs, and especially their children got a good result in exams (see Section4.4.3 and 5.4.3).

In conclusion, about the question of how these participants adapt to their roles, both Teacher A and Teacher B accepted their new roles within three classes. At the beginning of this study, they were not accustomed to being a spectator in the class, and they always wanted to interrupt the discussion and voice their own opinion on the questions. When they found students used an irrelevant keyword to search for answers, they could not help correcting students and giving them an exact keyword. Teacher A was interested in hearing the students' answers in the early discussion stage, and if she thought the answers were incorrect, she gave her own answers to the group directly. This situation was addressed after the researcher offered Teacher A guidance on about how to adapt her role in a SOLE. In the first three classes, Teacher A arranged the students in SOLE groups because she was worried she could not manage the noisy class effectively. However, when Teacher A and the students became more familiar with the SOLEs, students were allowed to self-organise into their groups. Gradually, these two teachers began to trust their students, and they believed that students could solve problems by themselves, and then they played the role of a good mediator in the

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SOLE class.

The students spent around five classes adapting to their new roles. In the first few classes, students sometimes used some inaccurate and irrelevant information to answer the questions, but gradually, they began to interrogate internet sources more thoroughly. Occasionally, some of the students in a group started to do something else if there was nothing to do as someone else was using the laptop. The researcher found that most of the time, these students first communicated with their group members to ask for an opportunity to use the laptop, although they knew that they could have joined other groups to try if they could use the laptop. Students became experienced at positive behaviour, and each of them came to realise how to manage the learning tasks within a team. Of course, the unpleasant experience (e.g. history class, 06.03.2015, Student-22) made the students recognise the importance of choosing a team that could work together next time.

"Today I had words with someone because I did not let him touch the laptop when I was searching for information. He did not stay with our group, and I know I was wrong. I will examine my mistake." (06.03.2015, Student-22)

Students preferred to self-organise a group with their friends (e.g. history class, 13.11.2014, Student-14), because some of them were too shy to express their idea when joined a group with unfamiliar classmates. These students felt free to speak up with their friends, and they no longer feared the embarrassment of their errors when expressed their own opinions to answer any questions.

"Today I self-organised group with my best friends, we have the tacit understanding, and we are the first group answered all questions." (13.11.2014, Student-14)

As discussed above, the parents keep their role to monitor their children to complete homework and urge children to learn all the time, and most of them only accept their new role to encourage their children to learn with SOLEs after their children got a good exam result.

More specific information will be discussed in the next Section.

6.2.3 *Participants' Attitudes towards a SOLE*

As discussed in Section 6.2.2, the teachers, students, and the parents have new roles in the SOLEs. Before the introduction of a SOLE, some participants thought learning should be fun, and some of them believed that learning should be hard work. Those participants who did not like Internet-based learning were worried that if students indulged in the Internet, it would affect their academic performance seriously. Mitra (2013) indicates that 'the internet can harm, but can also be a child's good tool for learning'. For example, it is difficult to keep children safe on the Internet due to online cheating, cyber bullying, and threats to privacy, but children can find a lot of useful resources online. However, in China, some parents even keep their children away from TV and the Internet to avoid affecting their school achievements. As Huang and Prochner (2004) claimed, parenting style is a principal factor that influences children's performance, and it directly relates to children's school achievement and goal setting.

As mentioned in section 2.2.4, some academics suggest that teachers should envisage using technology to educate children because Internet technology has become an indispensable tool that will further engage students in learning (Liaw et al., 2007; Chow, 2015; Kisanga, 2016; Perry, 2018). However, Fullan and Langworthy's article (2014) indicate that where technology is used, research findings on its impact on learning outcomes are disappointing. According to Gorder (2008) and Chow (2015), it seems likely that some teachers do not want to incorporate technology into their classroom because they are not very comfortable with it. Himsworth (2007) reported that only 20% of the teachers interviewed are comfortable using technology in the classroom, and Kisanga's findings (2016) indicate that 47% of the teachers had a negative attitude towards e-learning. Liaw et al. (2007:1069) indicate that 'no matter how advanced or capable the technology is, its effective implementation depends on users having a positive attitude toward it'. Thus, when the researcher analysed participants'

feedback, their responses were categorised by positive, negative, neutral responses, and others (see Section 4.4 and 5.4).

For the history class, the researcher collected 1001 diary forms from students in twenty classes, and there were 4062 positive responses, 893 negative responses, and 1097 neutral responses with their feedback (see Section 4.4.1). Most students enjoyed solving problems in a SOLE, and they also admitted that the online resource was a powerful tool to support their learning. For example, students wrote down their positive and negative comments as (details see Section 4.4.1):

"Learning in the SOLEs is a good experience. It will broaden my mind and help me establish a new point of view on thinking, and I like to discuss problems through the group cooperation, I am continuously learning from others' advantages." (29.05.2015, Student-36)

"Not enough time to answer all questions because we selected the wrong keywords. We will carefully analyse questions next time." (13.03.2015, Student-35)

Teacher A provided twenty diary forms, and there were 142 positive responses, 85 negative responses, and 65 neutral responses with her feedback (see Section 4.4.2). Teacher A was satisfied with students' performance in the SOLE, her positive and negative responses recorded as (details see Section 4.4.2):

"Network environment provides an advantage for students' self-organised in History, and to develop students' cooperative study ability in the SOLEs is a necessity in the present development of educational reform." (04.12.2014)

"I am not familiar with control the classroom instructions in a networked environment, and learning in the SOLEs is also entirely new to my students. All the students were very excited today, and I worried they could not completely devote themselves to study due to hyperactivity. Most students did well in this lesson, but some students used the laptop for a reason not

related to a SOLE task, I did not think it is good."   (19.09.2014)

For the parents, when this SOLE study finished, 84% of them thought that the SOLE is an acceptable learning method, and there were 52 parents expressed a positive attitude and 5 parents gave a negative attitude on using the SOLE in history lessons (see Section 4.4.3). Almost all of negative comments mentioned the same point—their children failed to get measurable gains in three exams (see Section 4.5.2). As we discussed in Chapter 2, it is unavoidable that most parents always use the exam results to evaluate child's capacity for learning in China, and in their eyes, the learning process is only important if it leads to good exam results. Parents' positive and negative attitudes recorded as (details see Section 4.4.3):

"Before this experiment, I always limited my daughter to access the Internet, and I thought Web surfing would distract children. Now I think spending some time on the Internet is not a bad thing for my child, and we can make it seem like a balanced learning style."

"There was no significant change in her exam scores. She said she did not like learning with anyone together in a group, and she preferred to learn in the traditional way. If the SOLE method is not suitable for my daughter, then I have to say I cannot give any positive evaluation about it."

For the maths class, the researcher collected1004 diary forms from students in twenty classes: 454 for geometry lessons and 550 for algebra lessons. In total, for the geometry lessons, there were 1933 positive responses, 206 negative responses, and 79 neutral responses. For the algebra lessons, there were 479 positive responses, 1691 negative responses, and 402 neutral responses (see Section 5.4.1). Most students believed that plane geometry lessons brought them much fun, but they felt frustrated when they did algebra tasks in the SOLEs. For example, students wrote down their positive and negative responses as (details see Section 5.4.1):

"There are many interesting pictures about triangles online, and I found that many live items are triangles such as coat hangers, road signs, pyramid, suspension bridge, pocket billiards setup, and *sailing ship… there are not in the book, wonderful!"* (08.10.2014, student-27)

"It was a little difficult to understand the literal interpretation of what Exponentiation is via online resources, and I could not retell it by myself. One of the group members summarised its formulas, and this made it easier to understand." (18.11.2014, student-27)

Teacher B completed all her twenty diary forms in the SOLE classes, including 9 for geometry lessons and 11 for algebra lessons. In total, for geometry lessons, there were 57 positive responses, 6 negative responses, and 39 neutral responses. For algebra lessons, there were 21 positive responses, 91 negative responses, and 11 neutral responses (see Section 5.4.2). Teacher B often complained that she was never able to meet all her teaching objectives when the students were learning algebra in the SOLEs. Teacher B's positive and negative comments as (details see Section 5.4.2):

"I was satisfied with students' answers to my questions. It surprised me that they found out so many interesting images of triangles. I believe these pictures which are not part of their textbook will help students make better sense of the geometry concepts." (08.10.2014)

"Almost everything students do in a maths lesson will depend on knowledge points that they have previously learned. It will be not easy to learn something new if students could not acquire and master all critical teaching points and difficult points of the day. At present, I still do not know how to design appropriate maths questions to let students throw themselves into the SOLE, and the classroom learning results are not ideal. The maths teacher should keep informed of students' needs to provide an adequate guide and help to them. However, although we have realised there is a little bit of a problem in the SOLE class, we have no idea where to start looking for the solution." (25.11.2014)

For the parents, when this SOLE study finished, 93% of parents were willing to encourage their children to keep using the SOLE method for plane geometry lessons, but only 14% of them wanted their children to go on learning algebra by the SOLE approach (see Section 4.4.3). In total, there were 12 parents expressed a positive attitude, 29 parents gave a negative attitude, and 16 parents maintain neutrality on using the SOLE in maths lessons. Parents' positive and negative attitudes recorded as (details see Section 5.4.3):

"I believe the SOLE method plays a useful role in the maths lesson, at least my child can benefit from it, and his test scores increased slightly. It is a good phenomenon."

"Maths is not like history. I admit that the SOLE method is useful to improve her study interest and academic performance, but this is not easy to understand and solve all maths problems by using the Internet. I do not want my child to have her maths lesson with the SOLE method, and it is not a good substitute for traditional teaching methods."

In conclusion, the SOLE is an innovative and creative approach to learning. Students could choose their own groups and solve problems by using an Internet-connected computer with minimal intervention from mediator, and they can focus on exploring an area which arouses their curiosity. The SOLE has the potential to help students access up-to-date information, acquire skills and solve problems efficiently in collaboration with other learners. A majority of students, teachers and parents agreed that the SOLE is a good learning approach to improve learners' learning outcomes in history and geometry, but is not applicable for algebra. However, some of the participants still refused to accept learning in a SOLE, because learners did not improve the exam scores after learning in the SOLEs, and they perceived conventional teaching as more trustworthy.

6.3 Using Technologies in Learning

In section 2.2.2, the researcher reviewed the Internet-assisted learning and teaching environment, since the SOLE method is based on the use of Internet resources, here we need

to emphasise the importance of technologies and Internet information for students' learning progress. We have discussed the teachers' and parents' attitudes on the Internet-based learning environment in the above section, where most of them thought that the computer or other electronic devices for children are just for entertainment, and this attitude is also the main reason why some of them are not willing to support children learning in the SOLEs. According to the researcher's observation, School A also arranged computer lessons for students, but these lessons merely focus on developing students' computer and Internet skills, such as teaching students to be proficient in using Office software. However, as Vockley (2007:3) said, 'technology proficiency is simply the point of entry to the digital world—and it is only a small sliver of the far-reaching utility of technology as a powerful enabling tool for a full range of essential knowledge and skills'. Vockley (2007) describes the pivotal role of technology in a 21st-century education system (see Section 2.2.2), and he also suggests that citizens should master some basic computer skills and accept the advantages and disadvantages of the Internet in order to perform effectively in the 21st century.

Of course, to accept the new technology in learning does not mean we need to give up traditional teaching, because both are essential to learning. Both learning methods have their own advantages and disadvantages, and we just attempt to stress the importance of technologies, Internet resources and cooperative learning, which bring a different learning process. Technologies and Internet resources are the powerful tools for instruction. Technologies are cognitive tools help learners to elaborate on what they are thinking and to engage in meaningful learning. The Web becomes a common tool for learner-centred or constructivist learning. It is hard to change teachers and parents' ideas within a short time, but in the future, we can establish some procedures to help them understand how to treat digital technologies as tools for learning, not just for entertainment. After all, the learning outcomes of students depend on what opportunities the teacher and parent provide. However, the researcher agrees with Cuban (2013) and Paradowski (2014) that high-tech schooling may be useful in the appropriate situation, but we should not have excessive magical thinking about the technology. Learning in a SOLE could provide learners more opportunities to acquire

knowledge, but Internet resources and hand-held devices could not entirely replace teachers.

6.4 Framing and Constructivism in the SOLEs

(1) Framing in the SOLEs

Basil Bernstein's concept of 'framing' is considered as the theoretical framework for this SOLE study. Bernstein (1990:36) indicates that 'control is always present, whatever the principles. What varies is the form the control takes. The form of control is here described in terms of framing'. Where framing is strong (+F), the person making the transfer/transmitter explicitly controls the selection, sequencing/organisation, pacing, criteria, posture, and dress of the communicants (Interactional), together with the arrangement of the physical location (Locational) (Bernstein, 1990; Bernstein 1996; Hoadley, 2006; Badger, 2010; Erixon, 2010; Pausigere, 2016). Where framing is weak (-F), the recipients/acquirers may have a greater degree of control over the distinguishing features of the interactional and locational principles, and the control given by the transfer could be withdrawn at any time (Bernstein, 1990; Hoadley, 2006; Badger, 2010; Erixon, 2010; Pausigere, 2016).

The finding from Li and Ginsburg (2006) suggest that teachers and students in China have almost no flexibility in deciding what is taught and learned, especially China's maths textbooks exhibited a higher degree of classification and framing than either the US algebra or the US non-algebra books (see Section 2.4). Erixon (2010) tends to argue that when we integrate the technology into the content of teaching, the conventional textbooks lose their role in the teaching, students may often be more proficient in than their teachers, and teachers would be less able to prepare teaching content presented by the textbook.

We could discuss the concept of 'framing' into this SOLE study. In the non-SOLE class (the conventional curriculum), teachers decided how teaching would occur without consultation with the students, and teachers controlled the selection of content, sequencing, pacing, and evaluation criteria. The curriculum knowledge was determined by the syllabus and textbook,

and teachers also explicitly controlled the relationships between teacher-students and student-student. This situation refers to a limited degree of options for students, therefore, it was a strong framing (+F).

In a SOLE session, teacher created a student-centred and activity-based learning environment, and students self-organised groups and learning occurred through much collaboration and discussion. Students could select how learning would occur, they were free to browse rich content online and discuss questions based on the Internet resources, and further selected what knowledge and content they were more interested. Students also could be free to observe what other groups were doing and shared information with each other. Although the teacher posed questions followed by the syllabus in a SOLE, the knowledge content was determined by the students rather than the teacher. Students controlled learning content within defined boundaries following consultation with the teacher (i.e. complicated algebra problems) or controlled their learning without consultation with the teacher (i.e. history and geometry problems), and they also controlled the nature of the relationships. It represented a weak framing (-F). However, this research aims to observe how effectively a SOLE can be incorporated into curricula within an 'exam-oriented system' in China, although students controlled the selection of content, sequencing, and pacing in the class, teachers and institutions controlled the evaluation criteria. On this point, it represented a strong framing (+F).

As Dolan et al. (2013:12) argued, '…SOLEs have the potential, particularly when pupils have some responsibility for generating and refining questions, to reframe the relationship between learner and teacher, and learner and curriculum'. The author believes that in a digital age, the development of curriculum will be more and more inclined to a weak framing (-F).

(2) Constructivism in the SOLEs
The researcher reviewed learning theories in Section 2.5. Social constructivism is thought of

as a learning theory with roots in cognitive constructivism (Piaget, 1977) and socio-cultural theory (Vygotsky, 1978). McDonald and Gibson (1998) and Huang (2003) argue that most learners could benefit from social constructivism since social interaction and collaborative learning are combined, and learners could construct knowledge actively.

Social constructivism supports the view that knowledge is a cultural or negotiated artefact created in cooperation and understanding with others (Hyslop-Margison and Strobel, 2007). The SOLE learning approach focuses on the process by which the students take control of their learning. In the SOLEs, students have to complete their tasks via open communication, mutual help, and exchange of needed Internet resources. Especially, in the group discussion, students can set up their learning goals, look for relevant online information, decide on their learning pace and evaluate their progress.

The constructivist sense of active learning is engaging in and interacting with the surrounding environment to produce a personal understanding of the world. In the SOLEs, learning is not knowledge-transmitting from teachers to students, but knowledge-constructing by students themselves. Students are not the passive receivers of knowledge, and they can construct and expand knowledge based on their existing experiences, and through the collaboration and social interaction with their group members.

According to Wang (2013) and Wong (2014), in the Chinese conventional class, students see learning as a competition, they are accustomed to learning individually rather than in a group, and as a result they choose to learn competitively rather than cooperatively (see Section 2.3.4). Before the researcher conducted the SOLE research, it was hard to know that whether students in this school like or do not like learning in a group, because prior to the current study, the teachers had not used group work.

In this SOLE study, students in the non-SOLE group primarily studied alone with the teacher, and the curriculum was strict adherence to a fixed content on textbooks. Students in the SOLE group primarily searched for information online and constructed new knowledge in groups. According to the classroom observation and participants' comments (see Section 4.3.1, 4.4.1, 5.3.1, and 5.4.1), small group learning in the SOLEs can improve students' self-confidence, as explained in section 6.2.2, as the students who are always shy to express their idea in the class will feel free to speak up when they do a SOLE task in a group with their friends together, and they no longer fear the embarrassment of their errors. Cooperative learning is also beneficial in developing students' communication skills, such as explaining, listening, discussion, questioning, presenting and defending a position, as we discussed in Section 6.2.1. The findings of this SOLE study suggest that Chinese students can also adapt to their new roles in the SOLE class, as most of them enjoyed the group discussion for cooperative learning, and most of the time groups are more effective at solving problems than individuals. Compared to the students who are in the traditional education system, students in the SOLE group are more cooperative and less competitive.

Social constructivism also emphasises that all cognitive functions including learning generally depend on interactions with teachers, peers, parents, and so on (Vygotsky, 1978). Section 2.2.4 described the significance of a mediator in a SOLE, so it is worth noting the role of a mediator in constructivist environments. In a SOLE, learning is learner-centred, rather than teacher-centred, but teachers could be flexible as a mediator. Stronger students could solve their problems by themselves, while weaker students occasionally needed extra help from their teacher. As a friendly facilitator, teachers in the SOLEs create an environment in which they can scaffold to support students in constructing knowledge. Constructivism insists that learning always proceeds from the known to the new, and a good mediator should understand how to provide the help based on this connection.

In the SOLEs, one of the teachers' roles is to allow the learners to do as much as they can on their own, and then to intervene and give help when it is needed so that the questions could be successfully answered. Students develop new cognitive abilities when a teacher leads them through task-oriented interactions. Teachers should assist them to develop competence as they engage in challenging tasks in which they can be successful. The findings in this research appear to confirm Vygotskian theorists' view that students can engage in complex tasks which they can successfully complete with appropriate help. Vygotsky (1978) insisted that what the children can do with assistance today they can do alone tomorrow. In this SOLE research, for teachers, parents, and students, the expected result is that students could get a high score in the examinations without any help.

In addition, reflection is widely used in settings based on constructivist approaches. Jonassen (1992) indicates that constructivist teachers allow learners to have an active role in the evaluation process, and Vrasidas (2000) claims that evaluation of one's own work promotes self-reflective skills, which is another goal of constructivist learning. Lake and Tessner (1997) also note that offering learners the opportunity to evaluate their own work will help them gain ownership of the evaluation process, thus making them responsible for their own learning. As introduced in Section 4.4 and 5.4, in this SOLE study, teachers and students also needed to write reflective diaries after each SOLE class (see Appendix E and F). The researcher invited participants to answer some questions about their experiences in the SOLEs of the day, for helping them to recall their experiences and find out problems, and to do better next time.

Equally important, the Internet resource as the tool for the constructivist approach also deserves to be discussed. In a course based on constructivist principles, learners should be offered the tools, resources, and support to manage their own learning and assigned tasks. Jonassen (1992) argues that the emphasis in constructivist learning environments is not on confirming that specific knowledge has been learned, but on identifying necessary tools that support learners in constructing knowledge. Some academics tend to argue that online

learning environments have become a common tool for learner-centred or constructivist learning. The application of technologies and other cultural tools to interact, exchange information, and construct knowledge are fundamentals to constructivism (Bruner, 1966; Vygotsky, 1978; Jonassen, 1996; Dede, 1996; Huang, 2002; Mishra 2002). In the SOLEs, the Internet resource is a key instrument to assist students in constructing their new knowledge in groups.

After conducting this SOLE study, the researcher found that the cooperative learning by using the Internet resources will be useful in the education domain. As Mitra and Crawley (2014:79) claimed, 'Children, working in groups and using the Internet, seem capable of learning content traditionally considered to be ahead of their time and comprehension levels'. This study lends qualified support to Mitra and Crawley's findings, but the results suggest that context is important. In this SOLE study, although some students prefer to learn independently, they also admit that learning in the SOLEs is a good way to help them master the skill of using the Internet to search for learning resources, and it was helpful to construct new knowledge with abundant resource.

6.5 Chapter Summary

This Chapter restated the purpose of this study and explained the research findings on three research questions. It discussed the effectiveness of a SOLE within school curricula, and discussed the new roles of participants and their attitudes toward the SOLEs. The researcher also discussed the concept of 'framing' and 'constructivism' in the SOLEs, which can provide guidance and theoretical support for the future research.

Chapter 7. Conclusion

7.1 Introduction

In the final chapter, Section 7.2 provides a summary of the findings of the three research questions and revisits some theories and issues mentioned in Chapter 2, the literature review. Section 7.3 presents limitations and de-limitations based on the principles of trustworthiness covered in Chapter 2, and also states some strengths of this study. Section 7.4 concludes the implications for practice and offers directions for future study in SOLEs.

7.2 Summary of Findings and Discussion

This thesis began with a contextual introduction to the research, regarding the background of the SOLEs and the SOLE study in China. Chapter 2 mainly reviewed the development of SOLE research and gave a detailed introduction to China's education system, and provided a review on the concept of 'framing' and 'constructivism'. Chapter 3 proposed research questions, and also explained the research methodology used in this study for data collection and analysis. Chapter 4 and Chapter 5 introduced how the SOLE class was conducted for history and maths. The different roles the participants played and their attitudes towards the SOLEs were also analysed. Chapter 6 led to the discussion of all research findings, and three research questions were answered. The researcher also discussed the concept of 'framing' and 'constructivism' in the SOLEs, which can provide guidance and theoretical support for the future research.

This SOLE study aimed to investigate the effectiveness of a SOLE within a school curriculum (history and maths), and participants' roles and attitudes toward the SOLEs. To achieve such a goal, according to the mix methods, the following three research questions are addressed:

1) How effective is a SOLE method within school curricula for different subjects?

2) What is the effect of the roles participants play in a SOLE?

3) What are the attitudes of teachers, students and parents towards a SOLE?

First, according to the classroom observation of the SOLE and non-SOLE groups for the two

subjects, the researcher found that students in the SOLE group performed more actively in the history class (see Section 4.3). They were excited to discuss and find answers to history problems using the Internet resources, and they were very happy if they could find interesting reading material or videos faster than other groups. Students mastered more knowledge that could not be learned from their textbooks. For maths classes (see Section 5.3), students also enjoyed doing geometry tasks in a SOLE, because those interesting animations or videos and many dynamic graphics they found would help them quickly understand the relevant concepts for each geometric shape. However, they insisted that it was easier to learn algebra by conventional learning, because most of them could not solve algebra questions without the help from their Teacher.

According to students' history homework (see Section 4.5.1), the researcher found that students in the SOLE group had a good performance on the multiple choice questions as students in the non-SOLE group, but they had a better performance on essay questions. Most of the students gradually improved their ability to structure an essay answer with clear logical thinking and accurate terms. For their maths homework(see Section 5.5.1), the maths teacher found that students in the non-SOLE group could complete their algebra homework with a high degree of accuracy, but the homework results in the SOLE group always did not meet her minimum standards. In order to avoid students making the same mistake in the exams, the maths teacher had to spend extra time to help students to solve their problems, and students had to rework their homework carefully.

The researcher also compared three exam results for the SOLE group and non-SOLE group within two semesters. For the history classes (see Section 4.5.2), the rank of the SOLE group in comparison to other classes in the same grade increased from No.9 to No.1 within nine months, it seems likely that using the SOLE to learn history was more effective in helping students to enhance their academic performance than conventional teaching methods. For maths classes (see Section 5.5.2), the researcher found that students in the SOLE group got a

lower mean score than the non-SOLE group in each exam, and the class ranks of the non-SOLE group were always ahead of the SOLE group in all three exams. Even more, the rank of the SOLE class declined in relation to other class at the same grade level during the research period.

Taken together, in this SOLE study, students meet the definition of the effective learners from Watkins et al. (2002:5), and they are active in cooperation and constructing knowledge with others. The above discussions collectively show that a majority of students could get good performance with history and geometry in a SOLE, but they are in a negative situation if the maths teacher did not provide an intervention to help them solve the algebra problems.

Secondly, we need to consider what roles participants play in a SOLE, and how they adapt to their new roles. Previous studies summarised some teachers' roles in the traditional teaching in China, including knowledge provider, nurturer, devotee, instructor, prompter, culture transmitter, authority, interest arouser, and co-worker (Cui and Liu, 2009; Wan et al., 2011). According to the classroom observation (see Section 4.3.3 and 5.3.3) and teachers' reflective diaries (see Section 4.4.2 and 5.4.2), it could be seen that teachers are no longer the knowledge provider, culture transmitter, devotee and authority, and they are becoming a mediator, facilitator, and friendly spectator in a SOLE.

Previous studies also reviewed the role of students in the traditional education in China. Various academics have concluded that Chinese students tend to be passive learners who seldom ask questions in class and they depend more on teachers for information and reply more in the use of rote learning and memorising (Murphy, 1987; Ballad and Clanchy, 1991; Chan, 1999; Xiao, 2006). However, the students' role in the SOLEs was changed (see Section 4.3.1 and 5.3.1). They were required to complete learning tasks collaboratively by using Internet resources, so they no longer passively accepted knowledge by a teacher, textbook, or blackboard. When students used Internet resources as the tool for interacting with others, they

were in an active position, and knowledge was constructed by students themselves in a group. In brief, in the SOLEs, students are no longer the passive receivers of knowledge. They become an active constructor of knowledge, an autonomous learner and a collaborative participant, and they begin to build up active and probe learning methods.

Previous studies indicated that Chinese parents do put too many expectations and pressure on children because only top-performing students may enrol in prestigious universities, get recruited for high status jobs, and enjoy opportunities that are off-limits to lower scoring students (Kirkpatrick and Zang, 2011; Chen, 2016), so most parents saw their role as monitoring their children to ensure they complete homework earnestly and urging children to learn all the time. In this study, according to the questionnaire feedback (see Section 4.4.3 and 5.4.3), it seems likely that most parents still keep their role to monitor their children to complete homework and study hard all the time, but they also accept their new role to become a friendly mediator to encourage children to learn history and geometry in the SOLEs, even encourage their children to use the Internet at home for their studies. Of course, they would like to accept their new role because their children enjoyed doing tasks in the SOLEs, and especially their children got a good result in exams (see Section 4.4.3 and 5.4.3).

Thirdly, the researcher also analysed the participants' attitudes towards the SOLEs based on the reflective diaries from teachers and students, and questionnaires from parents (see Section 4.4 and 5.4). According to the previous research, some academics indicate that where technology is used, research findings on its impact on learning outcomes are disappointing, and teachers had a negative attitude towards e-learning (Himsworth, 2007; Gorder, 2008; Fullan and Langworthy, 2014; Chow, 2015; Kisanga, 2016). In this study, for the history class, the researcher found that most students admitted that the online resource was a powerful tool to support their learning and they enjoyed solving history problems in a SOLE (see Section 4.4.1). The history teacher was satisfied with students' performance in the SOLE (see Section 4.4.2), and when this SOLE study finished, there were 84% of parents thought that learning

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history in a SOLE is an acceptable learning method (see Section 4.4.3).

For the maths class, most students stated that plane geometry lessons brought them much fun, but they felt frustrated when they did algebra tasks in the SOLEs (see Section 5.4.1). Maths teacher often complained that she was never able to meet all her teaching objectives when the students were learning algebra in the SOLEs (see Section 5.4.2), and there were 93% of parents were willing to encourage their children to keep using the SOLE method for plane geometry lessons, but only 14% of them wanted their children to go on learning algebra through the SOLE approach (see Section 5.4.3). In conclusion, a majority of students, teachers and parents agreed that the SOLE is a good learning approach to improve learners' learning outcomes in history and geometry, but is not applicable for algebra.

Additionally, Basil Bernstein's concept of 'framing' is considered as the theoretical framework for this SOLE study (see Section 2.4). The previous finding from Li and Ginsburg (2006) suggest that teachers and students in China have almost no flexibility in deciding what is taught and learned, and especially China's maths textbooks exhibited a higher degree of classification and framing(+F). In this SOLE study, the researcher found that students could select how learning would occur, and further selected what knowledge and content they were more interested, the knowledge content was determined by the students rather than the teacher. Students controlled learning content, and they also controlled the nature of the relationships. This situation represents a weak framing (-F). However, this research aims to observe how effectively a SOLE can be incorporated into curricula within an 'exam-oriented system' in China, although students controlled the selection of content, sequencing, and pacing in the class, teachers and institutions still controlled the evaluation criteria. On this point, it represents a strong framing (+F).

Moreover, according to Wang(2013) and Wong (2014), in the Chinese conventional class, students see learning as a competition, they are accustomed to learning individually rather

than in a group, and as a result, they choose to learn competitively rather than cooperatively(see Section 2.3.4). Social constructivism emphasises that all cognitive functions including learning generally depend on interactions with teachers, peers, parents, and so on (Vygotsky, 1978), Students in the SOLE group primarily searched for information online and constructed new knowledge in groups. The findings suggest that Chinese students can also adapt to their new roles in the SOLE class, as most of them enjoyed the group discussion for cooperative learning, and most of the time groups are more effective at solving problems than individuals. Compared to the students who are in the traditional education system, students in the SOLE group are more cooperative and less competitive.

7.3 Research Limitations and Strengths

In Section 3.8, the researcher has mentioned the reliability and validity of this study, and four components of trustworthiness were discussed: 1) credibility (in preference to internal validity); 2) transferability (in preference to external validity/generalisability); 3) dependability (in preference to reliability); 4) confirmability (in preference to objectivity) (Shenton, 2004:64; Bryman, 2016). Considering the above principles, this SOLE study has some possible delimitations and limitations which have to be pointed out.

The researcher set the delimitation of this research in order to provide a clear focus. As reviewed in Section 2.3.4, Mitra and a number of other educators have repeated the SOLE experiments in many different countries, but there was no research into 'how effective a SOLE can be incorporated into curricula for different school subjects within an exam-oriented system' in China or elsewhere, so the researcher selected China to conduct this study. The participants of previous studies were mainly children under the age of 14, so the researcher also narrowed the target population down to the students from the junior high school. In order to answer the research question 'how effective is a SOLE method within school curricula for different subjects?', the researcher had to select more than one subject as the research objects, given the time constraints and in order to avoid interpreting results with too many moving

parts, the researcher only selected history and maths as the samples. In addition, considering the research design, the researcher spent about nine months to investigate the learning and teaching processes within a SOLE and participants' roles and attitudes toward the SOLEs. The researcher used mix methods to collect data, but most of them are qualitative data. Ethnographic research provides the researcher with the chance to observe and analyse these situations in a SOLE (see Section 3.3).

Unavoidably, some considerable limitations also existed in this study. First, this SOLE study has adopted triangulation strategy to enhance the credibility of the findings (see Section 3.3). However, as mentioned in Section 3.5.5, almost all teachers in this school did not have enough energy to spend time giving the completed homework a grade on students' exercise books, teachers only put a tick next to right answers and a cross next to wrong ones, so the researcher could only record the general information of their homework in the notebook. Thus, this study could not collect specific 'homework scores' as a quantitative data. If circumstances allowed doing it, it should be collect and analyse.

Secondly, transferability means 'similar projects employing the same methods but conducted in different environments could well be of great value' (Shenton, 2004:69). In this study, the researcher provided a sufficiently detailed description of the research contexts, research approach, and participants in this research, which would allow for the transferability to other settings. However, this study was only carried out in a particular school with one SOLE class in China, and the sample size was small. It limits how far the researcher can claim the results are generalisable, so the research findings need to be corroborated in larger cohorts. Moreover, this study was only carried out with eighth-grade students (see Section 3.4.2), and it would be useful to evaluate the use of SOLEs with other grades in the future, in order to investigate whether the process and outcomes of using SOLEs vary with the grade - and age - of the students.

Thirdly, in this study, in order to enhance the 'confirmability' of the findings, the researcher had tried to avoid potential bias or personal motivations via triangulation, and made the findings were based on participants' responses accurately and objectively. However, it is necessary to consider the novelty (Hawthorne) effect. Learning in a SOLE is a new experience for students, so maybe students got a short-term performance boost for the productivity. When the researcher carried out this study, most of the students were interested in learning in a SOLE, but over time, it is hard to say whether students would like to keep using it, because novelty cannot sustain itself. The researcher cannot determine whether students changed their behaviour simply because special attention was being paid to them. If so, this might have affected their performance and attitude.

Fourthly, it was difficult to say why SOLE was more effective for history than for maths. The preliminary conclusion is that history mainly depends on marshalling facts, and allows alternative answers, whereas maths requires a different kind of thinking and understanding, perhaps a different approach to tackling problems, and only requires a single correct answer. Thus, before moving on to try SOLEs with other subjects, it would be useful to consider whether different subjects do require different types of thinking, as, if so, this might imply either that SOLEs are more appropriate for some subjects than others, or that different subjects would benefit from different ways of applying SOLEs.

Finally, the Internet censorship in China is an obstacle to using SOLEs. If Internet users search for the same keywords via 'Google' and 'Baidu' (the biggest search engine in China), they will get different results. The researcher tested it in the UK because Google is banned in China, so students were not able to use it. Sometimes, especially when students tried to find some information about history topics via Baidu, they always got a blank screen that says 'page cannot be displayed'. China's Great Firewall, a massive Internet surveillance and content control system, controls what citizens can read and discuss online. Some websites with Human rights group and sensitive materials are blocked, and even most sites with useful

learning resources are also difficult to access. Sometimes web users in China can access restricted content via Virtual Private Networks (VPNs), but in a recent crackdown, the Chinese government has begun to shut down VPNs and similar services. In the long run, the Internet censorship in China will prevent learners' innovation in the how effectively the Internet can be used in SOLEs, and learners may be denied access to information that could be helpful in constructing their understanding of particular topics.

This study contributes to the area of SOLE research. One of the features of this study is that it focuses on the under-developed regions of China, which are widely neglected when educational innovations are introduced. Previous studies did not investigate how to combine traditional teaching curricula with a SOLE to improve students' learning outcomes, and we did not know whether SOLEs can support the demands of different types of school subjects in China. Although this study was conducted with a small sample size, it still fills this research gap. Considering the dependability, through ethnographic research, the researcher provided enough information in the research report which included the research design and its implementation, the operational detail of data gathering, and assessment of this study. If other researchers wanted to replicate this study, they might obtain similar findings as this study did.

This study also provides the researcher with in-depth understanding regarding the concept of 'framing' and 'constructivism' in the SOLEs, which can provide guidance and theoretical support for the future research. The students in this study worked cooperatively to construct knowledge, and the SOLE combined with a teacher as mediator provides adequate scaffolding. It seems likely that SOLEs can be called a constructivist approach to teaching and learning, and the author believes that in a digital age, the development of curriculum will be more and more inclined to a weak framing (-F).

7.4 Implications for Practice and Future Research

The results of this study have implications for practice. As discussed in Section 6.2, a majority of students could get good results with history and geometry in a SOLE, although they are in a negative situation if the maths teacher did not provide an intervention to help them solve the algebra problems. Both teachers and students in the classroom changed their roles and gradually adapted to their new roles, and now most participants have positive attitudes to the Internet-based learning method, especially teachers realised that collaborative learning had benefits in SOLEs, so now they expressed willingness to use this approach in conventional classrooms. Moreover, teachers' experiences of SOLEs also helped them reflect on how they teach without SOLE.

One of the things we should realise is, most of the Chinese teachers in the traditional education system may need about three classes to adjust their position to a mediator, facilitator, or spectator in a SOLE. In the first three classes, although students did not ask for help, teachers could not help controlling their students like in a conventional class. When they are new to the Internet-based learning environment, the researcher should patiently observe and guide the teacher to adjust their role.

Normally, students should be allowed to choose their own groups in a SOLE. In this study, during the initial three classes, teacher A insisted on choosing the groups by herself because she was worried she could not manage the noisy class effectively if students were self-selected with their friends. When the teacher and the students became more familiar with the SOLEs, students were allowed to self-organise into their groups, and they could change their group as they wish during a lesson. The interesting finding is, the students prefer to discuss questions with their friends because some of them were shy about expressing their opinion or suggestions with students in groups arranged by the teacher. There was a pleasant atmosphere in the classroom when they self-orgnised their groups. Thus, the researcher suggests that teachers do not need to worry too much about group learning, because it seems

likely that most students have a sense of propriety to manage themselves, and they can experience the joy of learning in groups.

Occasionally, when students try to search for information online, they may not be able to find out useful information to answer the questions. Many factors are contributing to this situation, such as a shortage of online resources or students use the wrong keywords. In this case, the mediator should first provide guidance regarding selecting appropriate keywords, and encourage students to change a group to listen to others' advice, rather than give a right answer directly.

The researcher also found, when students share their findings with others in the last ten times, they are very hungry for teacher's praise, and they will be in a happy mood if they are praised. The researcher believes that positive feedback from teachers can improve students' motivation, and cultivate their self-confidence and abilities in learning with a SOLE. However, teachers should not overdo praise students if they realised something was wrong, they should encourage students to find out the similarities and differences between their answers.

From a methodological point of view, to have a complete understanding on the SOLEs, the use of mixed methods (e.g. questionnaire, interview, observation, diary form, exam results) are considered in this study. In particular, the observation and reflective diaries are regarded as essential research techniques that allowed the researcher to track continuously and collect specific data during the study. Furthermore, the ethnographic research approach was crucial, as it enabled the researcher to uncover the students' interaction with Internet resources and other participants. All the above factors make this study valuable.

As discussed in Section 3.3, establishing a rapport with the participants was very important to the ethnographic research. The researcher still keeps in touch with two teachers and a small number of the students after completing this study by WeChat and few face-to-face contacts,

for sharing their new experience and thought regarding Internet-based learning, and providing them assistance when they need. This process also made the researcher gain better insights into the application of the SOLEs.

We have summarised the specific research limitations of this study. It is clear that this study was only conducted in one school with small sample sizes, so the validity of the conclusions requires verification using a larger sample. Furthermore, researchers who are interested in the learning outcomes in a SOLE can try to develop ways of helping students construct their maths knowledge (while following the teaching syllabus in China) without, or with little, intervention. In addition, research is needed to investigate whether different subjects would benefit from different ways of applying SOLEs.

Moreover, the combination of a SOLE and cloud services can help the learners, teachers, and institutions acquire more learning resources through the website. In the future, for learners, it should be possible to access all kinds of education cloud services via a variety of terminals, such as an intelligent mobile, IPAD, laptop, PC, and so on, and the researchers may be able to carry out a SOLE study under any circumstance. In addition, in current SOLE studies, when the educators ask students to share their answers and discoveries, only one student at a time can do this thing. In the next step, maybe the simultaneous responding and interaction between learners within a SOLE can be supported by using Group Chat, Blogs or Discussion Forums based on the education cloud services. These are potentially valuable directions that worthwhile of further study.

7.5 Chapter Summary

In this chapter, the researcher gave a summary of the findings and discussion of this study, and stated the implications for practice. Limitations of this research were also pointed out, with the intention of proposing future research directions that will contribute to the findings of this study within China and beyond. To conclude, the researcher offered the substantial data

for future debate and discussion, but the observations are by no means conclusive. The researcher hopes this thesis will draw the attention of others to the field, and all researchers can make a contribution to bring more children into a SOLE.

Appendix A

Questionnaire regarding parents' or guardians' responses before the SOLE experiment
Date: 17/09/2014

Thank you for kindly participating in this questionnaire. This questionnaire aims to know your opinion on Internet-based learning environments.

It should take about fifteen minutes of your time. The questionnaire is anonymous, and your responses are voluntary and will be confidential. The information provided by you will be only used by Xueting Ma for her doctoral research and not for any commercial activity. If there are items you do not feel comfortable answering, please skip them.

If you have any questions or concerns, please contact the researcher Xueting Ma, Email: X.ma2@ncl.ac.uk, Tel: 13139079728.
Thank you so much for your cooperation and help!

1. How long is your child allowed to surf the internet every week?
A. Less than 2 hours   B. About 2-7 hours
C. About 7-14 hours   D. More than 14 hours

2. From your observations, what does your child do online frequently?
A. Searching learning resources   B. Chatting online   C. Playing online games
D. Listening to music or watching films   E. Not sure   F. Others_____

3. Do you monitor your child's Internet activity?
A. Yes   B. Occasionally   C. No

Why did you do it? Would you please write down the reasons? _____

4. Are you willing to support your child in learning with SOLEs?
A. Very high   B. High   C. Neutral   D. Low   E. Very low

5. Do you think the SOLE method will be an efficient learning model for learners who are in the eighth grade?
A. Effective   B. Uncertain   C. Ineffective

6. What is the problem that most concerns you about Self-organised Learning Environments?

7. What do you think about Self-organised Learning Environments? What are the advantages and disadvantages?

Appendix B

Interviewer: Researcher (Xueting Ma)

Interviewees: Four history teachers and five maths teachers in the Eighth-grade

Interview Setting: Interview conducted in an office in this school. The interview was conducted at 15:45 on Monday, 08 September, 2014, and all interviewees had at least one hour of free time.

Affiliation with interviewees: Before I conducted this interview, I have stayed in this school more than three weeks to prepare this SOLE study, so we all knew each other, and it had a comfortable and relaxed atmosphere during the interview.

1. What do you know about the Internet-based teaching and learning way?

2. Have you tried this way in your class?

3. What is your attitude toward the Internet-based learning methods?

4. Do you think the Internet-based learning is as effective as the conventional education?

5. How do you manage your classroom with the conventional education?

6. How do you make sure your students are on task?

7. How do you guide students to manage their own learning?

8. Do you guide students to solve problems by themselves?

9. Do you like dividing your class into groups to increase student participation in class activities?

10. Do you encourage your students to become problem designers?

11. How do you teach students to learn what you do not know?

12. What are your expectations for students to self-assess their learning?

13. What aspects of the teaching are you the most concerned about?

14. What do you think about the SOLE?

15. What is the problem that most concerns you about the SOLE?

16. What do you think about the benefits and limitations of the SOLE?

17. Do you think the SOLE method will be an efficient learning model for Eighth-grade learners?

18. Do you think learning in a SOLE is right for your courses (history/maths)?

19. Would you like to ask the students to learn in a SOLE in your class?

Appendix C

Date: 19.09.2014

Main Discussion Topic: History of The Old Summer Palace (1709-1860)

Questions posed by Teacher A:

1. Where is the Old Summer Palace?

2. When did construction of the Old Summer Palace begin? Moreover, why was it built?

3. What were special features of the Old Summer Palace?

4. What was happening from 1856 to 1860 here?

5. If you have the opportunity to introduce the Old Summer Palace to the foreigners, how will you describe it?

_____

Date: 26.09.2014

Main Discussion Topic: The First Opium War (1840-1842)

The First Sino-Japanese War (1894-1895)

Questions posed by Teacher A:

1. What do you know about the destruction of opium at Humen?

2. When did the First Opium War take place and what countries were involved in the war?

3. What were the main reasons and results of the First Opium War?

4. What were the main reasons and results of the First Sino-Japanese War?

5. Can you summarise the main events during the First Sino-Japanese War?

6. What do you know about The Treaty of Nanking and Treaty of Shimonoseki?

_____

Date: 10.10.2014

Main Discussion Topic: The Self-Strengthening Movement (1861 – 1895)

Questions posed by Teacher A:

1. What was the Self-Strengthening Movement?

2. Who led the reforms? Can you introduce the different roles they played and their aims

during the self-strengthening movement?

3. What achievements did the reformers make in 1861, 1862, 1878, and 1890?

4. Why did Self-Strengthening Movement fail?

_____

Date: 17.10.2014

Main Discussion Topic: The Hundred Days' Reform (1898)

Questions posed by Teacher A:

1. What was the background to the Hundred Days' Reform?

2. Could you introduce the role of Guangxu Emperor, Kang Youwei, and Liang Qichao?

3. What happened during the Hundred Days' Reform?

4. What were the long-term effects of the Hundred Days' Reform?

5. What can you learn from the Taiping Heavenly Kingdom Movement, Hundred Days' Reform, and Boxer Rebellion?

_____

Date: 24.10.2014

Main Discussion Topic: The Revolution of 1911 (1911-1912)

Questions posed by Teacher A:

1. What were the causes of the 1911 Xinhai Revolution?

2. Could you tell us something about the Revolutionary Alliance?

3. Can you try to describe the details of Wuchang Uprising?

4. What do you know about the Three Principles of the People?

5. Do you think the Revolution of 1911 was successful? Why or why not?

6. Summarise the historical significance of the Revolution of 1911.

_____

Date: 31.10.2014

Main Discussion Topic: The New Culture Movement (1915-1923)

Questions posed by Teacher A:

1. What was the background of the New Culture Movement?

2. Who were the key participants? What did they do?

3. Summarise the main events of the New Culture Movement.

4. What were the significance and achievements of the New Culture Movement?

_____

Date: 13.11.2014

Main Discussion Topic: The founding of the Chinese Communist Party (1921)

Questions posed by Teacher A:

1. What was the May Fourth Movement?

2. What are the effects of the May Fourth Movement?

3. When and how was the Chinese Communist Party founded?

4. What was the significance of the founding of the Chinese Communist Party?

_____

Date: 20.11.2014

Main Discussion Topic: The Northern Expedition (1926-1928)

Questions posed by Teacher A:

1. What was the purpose of the Northern Expedition?

2. Outline the preparation of the Northern Expedition.

3. Can you describe the main battles in the Northern Expedition?

4. Why was the Northern Expedition a failure?

_____

Date: 28.11.2014

Main Discussion Topic: The Mukden Incident (1931-1932)

The Nanking Massacre (1937-1938)

Questions posed by Teacher A:

1. What was the background of the Mukden Incident?

2. Summarise the timeline and main events of the Manchurian Incident.

3. Outline the results of the Mukden Incident.

4. Why did the Nanking Massacre happen?

5. What happened in the Nanking Massacre?

Date: 04.12.2014

Main Discussion Topic: The "Three Great Battles" (1948-1949)

<div align="center">The Liaoshen/ Huaihai/ Pingjin Campaign</div>

Questions posed by Teacher A:

1. Summarise the events of the Liaoshen Campaign;

2. Summarise the events of the Huaihai Campaign;

3. Summarise the events of the Pingjin Campaign;

_____

Date: 06.03.2015

Main Discussion Topic: The Founding of the People's Republic of China (1949)

Questions posed by Teacher A:

1. What happened in the Chinese Civil War?

2. What is the difference between the Republic of China and the People's Republic of China?

3. (1) Who was first premier of the People's Republic of China?

   (2) What do you know about him?

_____

Date: 13.03.2015

Main Discussion Topic: Agrarian Reform (1947–1952)

Questions posed by Teacher A:

1. Outline the Agrarian Reform Law published in 1950.

2. Outline the reasons and aims of the Reform.

3. Outline the stages of Agrarian Reform.

4. What were the effects of Agrarian Reform?

_____

Date: 27.03.2015

Main Discussion Topic: The First Five-Year Plan (1953—1957)

Questions posed by Teacher A:

1. What was the five-year plan?

2. What were the goals of the First Five-Year Plan?

3. How to assess the importance of the five-year plan?

4. What were the major problems of the First Five-Year Plan?

Date: 03.04.2015

Main Discussion Topic: The Four Cleanups Movement (1963-1966)

Questions posed by Teacher A:

1. What was the background of the Four Cleanups Movement?

2. What were the reasons and goals of the Four Cleanups Movement?

3. Outline the general process of the Four Cleanups Movement.

4. What were the results of the Four Cleanups Movement?

Date: 10.04.2015

Main Discussion Topic: The Great Proletarian Cultural Revolution (1966–1976)

Questions posed by Teacher A:

1. What were the reasons for the Great Proletarian Cultural Revolution?

2. Whose idea was it and what was the aim?

3. How long did the revolution last and what happened in this period?

4. How do you view the Cultural Revolution affect China?

Date: 17.04.2015

Main Discussion Topic: Chinese Economic Reform and Opening up (1978-1993)

Questions posed by Teacher A:

1. Can you describe the impact of Deng Xiaoping on the Chinese Economic Reform and Opening up?

2. What were the essential elements of the Economic Reform and Open Door Policy?

3. (1) What is a special economic zone?

   (2) How many special economic zones were created in 1980?

   (3) Why did China establish the special economic zones in these cities first?

4. Outline the main contents of the Reforms and Opening Up from 1978 to 1993.

_____

Date: 24.04.2015

Main Discussion Topic: Transfer of sovereignty over Hong Kong and Macao (1997/1999)

Questions posed by Teacher A:

1. (1) What does 'china one country two systems' mean?

   (2) Who formulated it?

   (3) Why did china desire this constitutional principle?

2. Summarise what you know about the transfer of sovereignty over Hong Kong from the United Kingdom to China.

3. Summarise what you know about the transfer of sovereignty of Macau from the Portuguese Republic to China.

4. What is the significance of Hong Kong and Macao returned to our motherland?

_____

Date: 15.05.2015

Main Discussion Topic: National Defense Construction and Diplomatic History (1950s-2001)

Questions posed by Teacher A:

1. Describe the development of the People's Liberation Army Navy from the 1950s to the 1990s.

2. Describe the development of the People's Liberation Army Air Force from the 1950s to the 1990s.

3. What are the Five Principles of Peaceful Coexistence?

4. How much do you know about the first large-scale Asian–African?

_____

Date: 22.05.2015

Main Discussion Topic: The Basic Education Reform and Development ((1950s-2001)

Questions posed by Teacher A:

1. Why was Compulsory Education Laws (1986) formulated?

2. What is the system of nine-year compulsory education in China?

3. (1) What was the China '973 Program'?

   (2) What were the major tasks of '973 program'?

_____

Date: 29.05.2015

Main Discussion Topic: The Great Scientific and Technical Achievements (1950s-2001)

Questions posed by Teacher A:

1. What was the most important contribution from Deng Jiaxian and Yuan Longping?

2. (1) What is the value of the 'Two bombs and one satellite' event?

   (2) What was happening in 1960, 1964, 1967, and 1970?

3. (1) What was the '863 program'?

   (2) What specific technological areas were developed by the '863 program'?

Appendix D

Date: 08.10.2014

Lesson: Plane Geometry

Main Discussion Topic: Triangle and Equilateral triangle

Questions posed by Teacher B:

1. What are the characterizations of the Equilateral Triangl

2. What are the similarities and differences between an equilateral triangle and an isosceles triangle?

3. Summarise the properties and determination of the Equilateral Triangle.

4. What live items are equilateral triangles in our daily life?

5. In this diagram, given AD=BE=CF, what shape is △DEF?, Why?
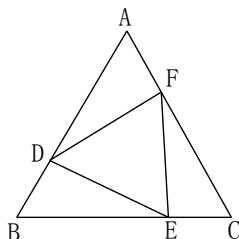
6. In this diagram, △ABC and △CDE are equilateral triangles．BE and AC are crossed at F , AD and CE are crossed at H，

　　(4) Prove：△BCE≅△ACD；

　　(5) Prove：CF=CH；

　　(6) What shape is △CFH? Why?

_____
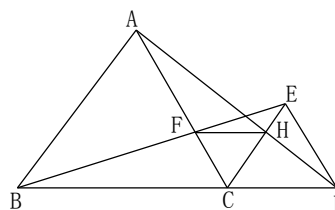
Date: 22.10.2014

Lesson: Plane Geometry

Main Discussion Topic: Axis of symmetry and symmetric figure

Questions posed by Teacher B:

1. What is the definition of reflection symmetry?

2. What is an axis of symmetry?

3. Can you give us some examples of reflection symmetry in nature?

4. (1) Which shapes are symmetrical? Please draw the axis of symmetry.
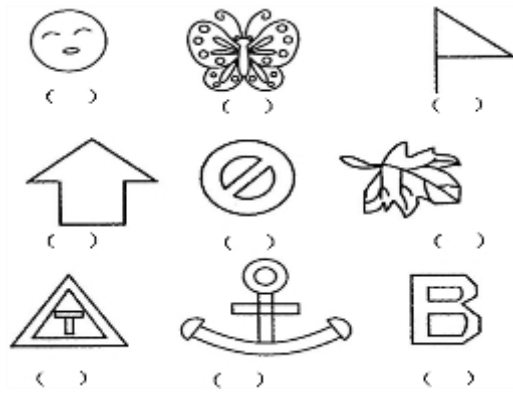
5. How many axes of symmetry does a rhombus have? How about a circle, ellipse, pentagon, square, rectangle, trapezoid, isosceles trapezoid, scalene triangle, and an isosceles triangle?

_____

Date: 10.11.2014

Lesson: Plane Geometry

Main Discussion Topic: Polygon and Interior angle sum

Questions posed by Teacher B:

1. What are the exterior angles and interior angles of a simple polygon?

2. How many diagonals does a quadrilateral have? How about a pentagon, hexagon, octagon, dodecagon, and an icosagon?

3. What is the easiest way to find out how many diagonals a Polygon has?

4. Using the diagonal formula to find the number of diagonals of a pentadecagon, heptadecagon, enneadecagon.

5. We already know that the interior angles of a triangle add up to 180 °, how to calculate the sum of interior angles of the following shapes?
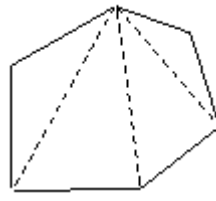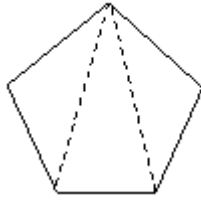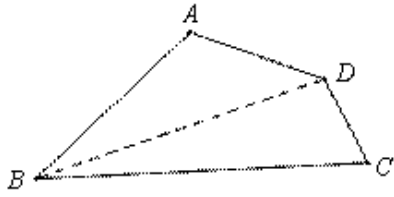
6. Can you set up the formula for calculating the sum of the interior angles?

7. What is the sum of interior angles in a 24-gon, 35-gon, and 63-gon?

_____

Date: 18.11.2014

Lesson: Algebra

Main Discussion Topic: Multiplication of Integral Expression

Questions posed by Teacher B:

1. What is the rule of multiplying exponents with the same base?

2. What is Factorization?

3. Which one is true?

   A. $a^3 \cdot a^2 = a^6$　　B. $b^4 \div b^4 = 1$　　C. $x^5 + x^5 = x^{10}$　D. $y^7 \cdot y = y^8$

4. If $a^m \cdot a^3 = a^5$, m=?

5. If $a = 3, b = -\dfrac{1}{3}$, $(a+b)(a-b) + (a+b)^2 = $?

6. Calculate: $\left(2a^2 - \dfrac{2}{3}a - \dfrac{4}{9}\right) \cdot (-9a)$;　　　　$(-3ab)(-a^2 c)^2 \cdot 6ab(c^2)^3$;

   $$\left[x\left(x^2 y^2 - xy\right) - y\left(x^2 - x^3 y\right)\right] \div 3x^2 y;$$

   $$(5x + 7y - 3)(5x + 3 - 7y);\qquad (2x^3)\,(-5xy^2);$$

   $$\left(-\dfrac{3}{2}x^2 yz^3\right) \cdot \left(-\dfrac{4}{3}xz^3\right) \cdot \left(\dfrac{1}{3}xy^2 z\right)$$

7. Calculate this system of inequalities:

   $$\begin{cases} x(2x\text{-}5) > 2x^2 - 3x - 4 \\ (x+1)(x+3) + 8x > (x+5)(x-5) - 2 \end{cases}$$

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Date: 25.11.2014

Lesson: Algebra

Main Discussion Topic: Formula for the difference of squares

Questions posed by Teacher B:

1. Do you know how to easily solve maths problems using difference of squares?

2. Which one is true?

A． $(a+3)(a-3)=a^2-3$ 　　　　 B． $(3b+2)(3b-2)=3b^2-4$

C． $(3m-2n)(-2n-3m)=4n^2-9m^2$ 　　 D． $(x+2)(x-3)=x^2-6$

3. Which one is true?　（　　）

　　A． $a-(b+c)=a-b+c$ 　　　　　 B． $x^2-4=(x-2)^2$

　　C． $(a-b)(a+c)=a^2-ab+ac-bc$ 　　 D． $(-x)^3 \div x^3 = x(x \neq 0)$

4. Calculate: (1) (2a-3b)(2a+3b);　　(2) (-p2+q)(-p2-q);

　　　　　　(3) $(X-2y)^2$;　　　　(4) $(-2x-2y)^2$

　　　　　　(5) $(2a-b)(2a+b)(4a^2+b^2)$;

　　　　　　(6) (X+Y-Z) (X-Y+Z) − (X+Y+Z) (X-Y-Z)

5. If a+b=10，a^2+b^2=4, calculate a=_____, and b=_____.

6. Given：

　　　　$1^2+ (1\times2)^2+2^2= (1\times2+1)^2$
　　　　$2^2+ (2\times3)^2+3^2= (2\times3+1)^2$
　　　　$3^2+ (3\times4)^2+4^2= (3\times4+1)^2$

　　　　……

　　(1) Write down the equation of line 2007;

　　(2) Write down the equation of line N, and explain your answer.

_____

Date: 03.12.2014

Lesson: Algebra

Main Discussion Topic: Formula for Perfect square trinomial

Questions posed by Teacher B:

1. Do you know which formula you can use to determine whether a trinomial is a perfect square, and to expand the trinomial quickly?

2. Which one is true?

A. $(a-b)^2 = a^2 - ab + b^2$

B. $(a+3b)^2 = a^2 + 9b^2$

C. $(a+b)^2 = a^2 + 2ab + b^2$

D. $(x+9)(x-9) = x^2 - 9$

3. (1) If '$x^2 + kx + 81$' is a perfect square trinomial, calculate k=_____.

(2) $(-4x+3y)^2 = $_____

(3) $(3x+2y+z)^2 = $_____

4. (1) Given x=-1/2, calculate: $(x^3+2)^2 - 2(x+2)(x-2)(x^2+4) - (x^2-2)^2 = $_____.

(2) Given $x^2 + 3x + 5 = 7$, calculate $3x^2 + 9x - 2 = $_____.

(3) Given x+y=4, xy=1, calculate $(3x)^2 + 9x - 2 + $_____.

(4) Given $a=\frac{3}{8}x-20$, $b=\frac{3}{8}x-18$, $c=\frac{3}{8}x-16$, calculate $a^2 + b^2 + c^2 - ab - ac - bc = $_____.

5. Prove: no matter what the value of x and y is, the result of $x^2 + y^2 + 6x - 4y + 15$ is always the positive number.

_____

Date: 05.01.2015

Lesson: Algebra

Main Discussion Topic: Comprehensive exercises

Questions posed by Teacher B:

1. Would you please find out ten exercises about the difference of squares and perfect square trinomial?

2. Calculate these exercises, and you can share your work with other groups.
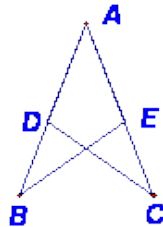
_____

Date: 05.03.2015

Lesson: Plane Geometry
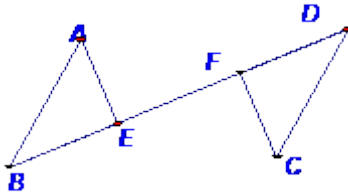
Main Discussion Topic: Congruent triangles

Questions posed by Teacher B:

1. What are the congruent triangles?

2. Summarise the ways to find if two triangles are congruent.

3. Given: AB=AC, ∠B=∠C; Prove: AD=AE.

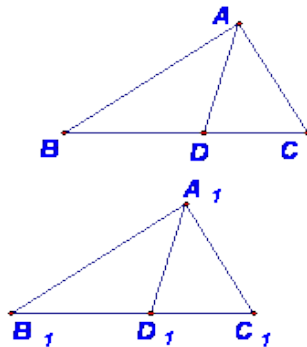   Given: AB=AC, ∠B=∠C; Prove: BD=CE.

4. Given: AB∥CD, AB=CD, ∠A=∠C; Prove: AE=CF

5. Given: △ABC≅△$A_1B_1C_1$, AD and A_1D_1 are angle bisectors of ∠BAC and∠$B_1 A_1 C_1$;

   Prove: AD= A_1D_1

_____

Date: 12.03.2015

Lesson: Algebra

Main Discussion Topic: Fraction

Questions posed by Teacher B:

1. Trying to summarise the concepts about the fraction and the forms of fractions?

2. What are algebraic fractions? Would you please give us some examples?

3. Do you know how to reduce fractions?

4. Are these fractions equivalent?

$$\frac{2}{3}, \ \frac{4}{6}, \ \frac{8}{12}, \ \frac{16}{24}, \ \frac{32}{48}.$$

5. What is the basic property of fractions?

6. Reduce fractions:

(1) $\dfrac{8a^3b^2c^4}{24\,a^2b^2c^3}$

(2) $\dfrac{(x+y)(a-b)^3}{(x+y)^2(a-b)}$

(3) $\dfrac{a^2bc}{ab}$

(4) $\dfrac{-32\,a^3b^2c}{24\,a^2b^3d}$

(5) $\dfrac{-4a^2bc^3}{16\,abc^4}$

(6) $\dfrac{x^2+4x+3}{x^2+x-6}$

Date: 18.03.2015

Lesson: Algebra

Main Discussion Topic: Fractional equation

Questions posed by Teacher B:

1. Summarise the steps for solving the fractional equation.

2. Solve these fractional equations for x:

(1) $\dfrac{3x}{x+2}+\dfrac{2}{x-2}=3$

(2) $\dfrac{3-x}{x-2}-2=\dfrac{1}{2-x}$

(3) $\dfrac{2}{3}+\dfrac{x}{3x-1}=\dfrac{1}{9x-3}.$

(4) $\dfrac{x-2}{x+2}-1=\dfrac{3}{x^2-4}$

3. If 'x=2', solve this fractional equation for a.

$$\frac{2ax+3}{a-x} = \frac{5}{4}$$

It was a little difficult to translate Question 4 and Question 5 into English here. They are two maths word problems about applying fractions in our lives.

_____

Date: 26.03.2015

Lesson: Algebra

Main Discussion Topic: Quadratic radical

Questions posed by Teacher B:

1. Please define what is quadratic radical?

2. What is the rationalizing factor?

3. How to simplify the radical?

4. Which square root radical is not a simplified?

$\sqrt{18}$ $\sqrt{23}$ $\sqrt{28}$ $\sqrt{33}$ $\sqrt{60}$ $\sqrt{153}$ $\sqrt{3a^2}$

5. Simplify the following:

$\sqrt{28}$ $\sqrt{45}$ $\sqrt{48}$ $\sqrt{66}$ $\sqrt{120}$ $\sqrt{200}$ $\sqrt{300}$

$\dfrac{\sqrt{20}}{2}$ $\dfrac{\sqrt{22}}{2}$ $\dfrac{\sqrt{72}}{3}$

_____

Date: 01.04.2015

Lesson: Algebra

Main Discussion Topic: Multiplication and division of Quadratic radical

Questions posed by Teacher B:

1. What are the principles of multiplying and dividing radical expressions?

2. Simplify the following:

(1)$\sqrt{18} \times \sqrt{45}$ (2) $\sqrt{18 \times 45}$ (3)$\sqrt{24} \times \sqrt{60}$ (4) $\sqrt{24 \times 60}$

(5) $\sqrt{a^3b^5}$ (a⩾0, b⩾0)

3. Simplify the following:

(1) $\sqrt{12} \times \sqrt{50} \div \sqrt{6}$ (2) $\sqrt{\dfrac{64}{9} \times \dfrac{144}{169}}$ (3) $\dfrac{1}{3}\sqrt{90} \div \dfrac{1}{2}\sqrt{40}$

4. If $a=\sqrt{2}+1$, $b=\sqrt{2}-1$, calculate $\dfrac{a^2-2ab+b^2}{a^2-b^2} \div \left(\dfrac{1}{a} - \dfrac{1}{b}\right)$

Date: 08.04.2015

Lesson: Algebra

Main Discussion Topic: Addition and subtraction of Quadratic radical

Questions posed by Teacher B:

1. What are the principles of adding and subtracting radical expressions?

2. Simplify the following:

① $\sqrt{20}-5\sqrt{\dfrac{1}{5}}-\sqrt{45}+\sqrt{125}$ ② $5\sqrt{x}+2\sqrt{x}$ ③ $2\sqrt{12}-\sqrt{27}+\sqrt{18}$

④ $3\sqrt{2}+\sqrt{3}-2\sqrt{2}-3\sqrt{3}$ ⑤ $2\sqrt{3}-\sqrt{8}+\dfrac{1}{2}\sqrt{12}+\dfrac{1}{5}\sqrt{50}$ ⑥ $\sqrt{12}+\sqrt{75}$

⑦ $(\sqrt{48}+\sqrt{20}) + (\sqrt{12}-\sqrt{5})$ ⑧ $\sqrt{54}+\sqrt{96}\;2\sqrt{12}-4\sqrt{\dfrac{1}{27}}+3\sqrt{48}$

3. If x and y are real numbers, $y = \sqrt{\dfrac{2x+1}{3-4x}} + \sqrt{\dfrac{2x+1}{4x-3}}+1$, calculate x+xy+x²y=_____

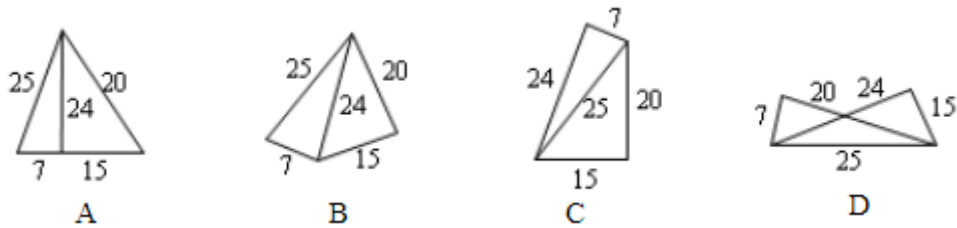**Date:** 15.04.2015

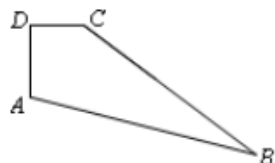**Lesson:** Plane Geometry

Main Discussion Topic: Pythagoras Theorem

Questions posed by Teacher B:
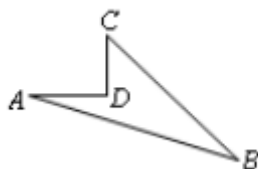
1. What is the Pythagoras theorem?

2. Which one is true?

A	B	C	D

3. Given AD⊥DC, AD＝8, DC＝6, CB＝24, AB＝26, so now what is the area of quadrilateral ABCD?

4. This is a land, and given AD＝4m, CD＝3m, AD⊥DC, AB＝13m, BC＝12m, figure out what is its area?

5. Given: AB=5cm, BC=3 cm, AC=4cm, CD⊥AB;

   So CD=_____, and the area of △ABC=_____.

_____
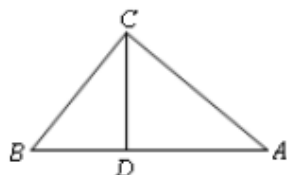
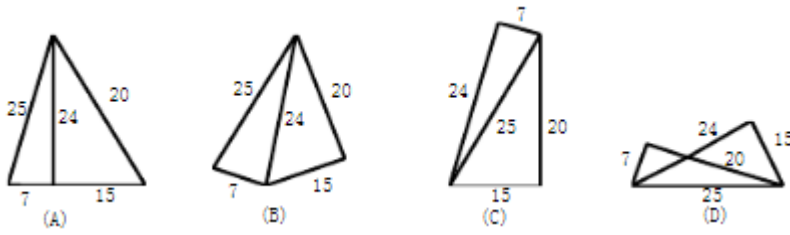**Date:** 23.04.2015

Lesson: Plane Geometry

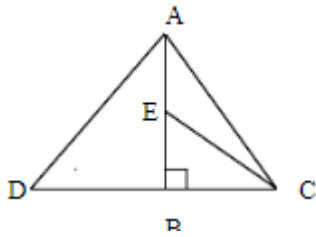**Main Discussion Topic:** Converse of the Pythagorean Theorem

Questions posed by Teacher B:

1. What is the converse of the Pythagoras theorem?

2. There are five wooden sticks, and they are 7cm, 15cm, 20cm, 24cm, and 25cm.

Which one is true?

3. AB⊥CD，both △ABD and △BCE are isosceles right triangles, CD=17, BE=5,

So AC=_____.

4. AD=7, AB＝25, BC＝10, DC＝26, DB＝24; Figure out the area of quadrilateral ABCD.
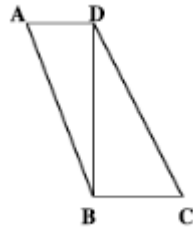
5. ∠ABD=∠C=90°, AD=12, AC=BC, ∠DAB=30°; So BC=_____.

_____
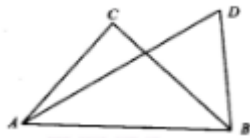
Date: 04.05.2015

Lesson: Plane Geometry

Main Discussion Topic: Parallelogram

Questions posed by Teacher B:

1. (1) what items are rectangles in our lives?

(2) What is a parallelogram?

(3) What is the difference between a rhombus and a parallelogram?

2. Can you give some examples of the parallelogram in nature?

3. How to calculate the area of a parallelogram?

4. If ABCD is a parallelogram, so∠ADC=_____ , ∠BCD=_____,

AB= _____, BC =_____.
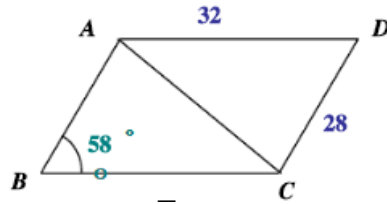
5. What is the area of parallelogram ABCD?
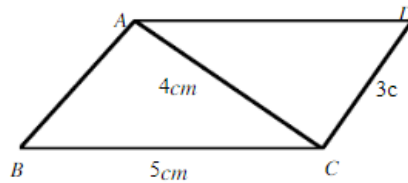
6. In △ABC, D, E, F are the midpoints of AB, AC, and BC;

(1) If EF=5cm, AB=_____cm; If BC=9cm, DE=_____cm.

(2) Prove the relationship between AF and DE.
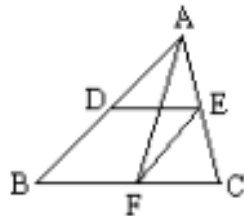
7. In parallelogram ABCD, which one is not true?

A. ∠1+∠2=180°   B.∠2+∠3=180°

C. ∠3+∠4=180°   D. ∠2+∠4=180°
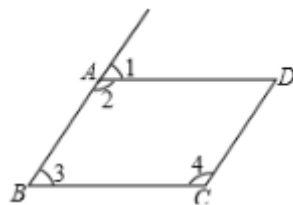
Date: 11.05.2015

Lesson: Plane Geometry

Main Discussion Topic: Basic Properties of Parallelogram

Questions posed by Teacher B:

1. Summarise the basic properties of parallelograms.

2. In parallelogram ABCD, given DF // BE, prove EO=OF.
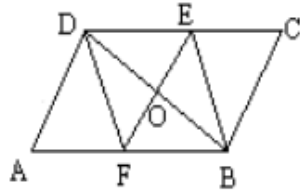
3. Given ∠1=∠2=∠3, BD=CD, ∠ADB=90°, CH⊥AB;

   (1) Prove CD // AB;   (2) Prove △BDE≌△ACE;

   (3) If point O is the midpoint of AB, prove OF=1/2 BE.
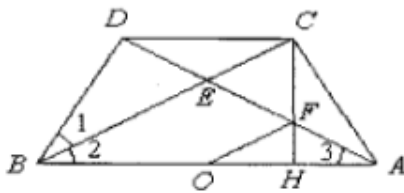
4. In parallelogram ABCD, point O is the midpoint of AC, and OE=OF;

   (1) How many congruent triangles in parallelogram ABCD?

   (2) Prove∠MAE=∠NCF.

_____
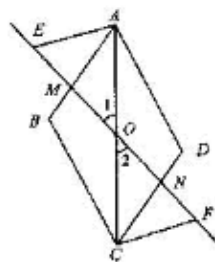
Date: 14.05.2015

Lesson: Plane Geometry

Main Discussion Topic: Area and Perimeter of a Parallelogram

Questions posed by Teacher B:

1. What is the area formula of a Parallelogram?

2. How to calculate the perimeter of a Parallelogram?

3. According to the given base side to draw the 'height' of following diagrams:

4. There is a vegetable garden is a parallelogram, the base side = 100m, height=50m, the
   yields is 125 tons per hectare. How many tons of the total yields in this garden?

5. The area of this diagram is 64 square meter, A and B are the midpoints of these two sides.
   Calculate the area of the dash area.

6. Known: the perimeter of a Parallelogram ABCD is 52, drawn the height DE⊥ AB, DF⊥ BC,
   E and F are foots of perpendicular. Given DE=5, DF=8, Calculate: BE+BF=?

_____

Date: 21.05.2015

Lesson: Algebra

Main Discussion Topic: Basic Properties of Linear function

Questions posed by Teacher B:

1. What is linear function? What is direct proportion function?

2. Outline the basic properties of a linear function.

3. Do you know how to draw a graph of the linear function?

4. Graphing a linear equation: y=3x+9

Graphing a linear equation: $y=\dfrac{2x}{7}+8$

Graphing a linear equation $y= -\dfrac{x}{9} +2$

5. If you have enough time, you can check your graphs by http://zuotu.91Mathss.com/, and

graphing more linear equations to observe their features.

_____

Date: 27.05.2015

Lesson: Algebra

Main Discussion Topic: Application of Linear function

Questions posed by Teacher B:

1. Known: As is shown in the graph, if $y = (a-1)x+b$, what is the range of a ?
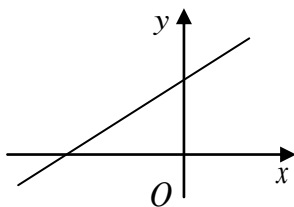
2. What is the functional analytic formula of this direct proportion function?
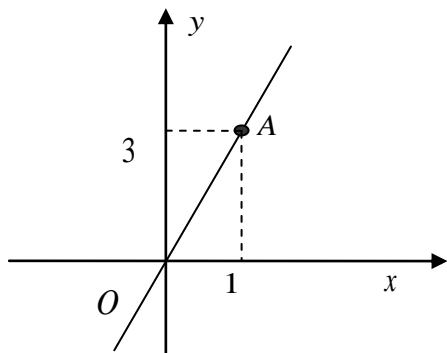
3. It is a directly proportional relation between y and x+1, when x=2, then y=1;

   Calculate, When x=-3, y = _____

It was a little difficult to translate Question 4 and Question 5 into English here. In brief, those

two maths questions were more complicated than above three questions, and they were also

relevant to the linear function.

Appendix E

Students' Diary Form

Dear students, thank you in advance for taking the time to complete this form to help us better understand your thoughts about the SOLE. There are no 'right' or 'wrong' answers, and you can choose not to answer questions if you do not feel comfortable with it. This diary form is anonymous, but you can write down your name if you prefer. Please submit this form to the subject representative before (Date and Time).

Student's name: _____ (non – mandatory)   **Date:** _____

1. What is the most rewarding part for you in this lesson?
2. What is the most challenging and easiest thing in this lesson?
3. How many students were in your group?   Did you change groups? Why?   What did you do in your group(s)?   How well did your group members do?
4. Did you find out the answers to all the questions? If not, would you please write down your reasons briefly?
5. How much of the content have you mastered?
6. What will you do differently next time?
Other Notes :   (You can write down any problem you still have in today's class)

Example of completed forms:

Class: History
Code：Student-36
Date:　29.05.2015

1. What is the most rewarding part for you in this lesson? "Learning in the SOLEs is a good experience. It broadens my mind and helps me establish a new point of view on thinking, and I like to discuss problems through the group cooperation, I am continuously learning from others' advantages."
2. What is the most challenging and easiest thing in this lesson? "We thought question-2 was a little hard to answer, because we had to search for historical events happened in different years, too much information made it difficult to summarise, but I had good group members, cooperative learning made it easier to resolve." "Question 1 and 3 were very easy for us because we completed these two questions in a short time. It's very interesting. When we shared our answers with other classmates, the teacher praised us!"
3. How many students were in your group? "Five." 　Did you change groups? Why? "No, all five of us didn't change our group because we cooperated very well". 　What did you do in your group(s)? "Another girl and I wrote down the answer to question two. I searched for question three. We discussed keywords and selected useful information together." 　How well did your group members do? "They are really great! In this interactive activity, everyone's task was unique, and we were responsible for our tasks."
4. Did you find out the answers to all the questions? If not, would you please write down your reasons briefly? "Yes, we solved all problems."
5. How much of the content have you mastered? "I think I remember the answers to question two and three now, but I still need to re-read my notes about question two, I am a little confused about those events."

6. What will you do differently next time? "This was our last SOLE class with you together, and I am very reluctant to you leave. If possible, I hope the teacher could allow us to learn history in the SOLE, always. I'm sure I can do it better next time."

Example of completed forms:

Class: Maths
Code: Student-3
Date: 27.05.2015

1. What is the most rewarding part for you in this lesson? "A classmate of another group gave us a big help when we didn't know how to search for relevant information."
2. What is the most challenging and easiest thing in this lesson? "We didn't complete all tasks. The maths problems were too complicated for us, and we had to spend a long time to solve each question."

3. How many students were in your group?
 	
"We had six people at the beginning of the class, two of them changed the group, and after that, another boy joined us."
 	
   Did you change groups? Why?
"I didn't".
 	
   What did you do in your group(s)?
"I searched for some relevant information and completed several questions on paper.
When we didn't know how to solve those problems, I was very anxious. I thought it affected the emotions of others, I should be more patient and active to complete our group tasks."
 	
   How well did your group members do?
"We've tried to solve these problems by ourselves, but I thought we needed interaction with our teacher. However, my group members thought we should complete them by ourselves, so we didn't consider seeking help."

4. Did you find out the answers to all the questions? If not, would you please write down your reasons briefly? "No. Questions were too difficult for us, we wanted to find out the processes to solve those

problems, but we only found out their accurate answers online. We still didn't know how to get the right results."

5. How much of the content have you mastered? "I'm not sure. I completed my homework just now, some maths problems were very easy for me, but some of them were very difficult, I couldn't work it out."
6. What will you do differently next time? N/A.
Other Notes : (You can write down any problem you still have in today's class) No.

Appendix F

Teacher's Self-reflection Diary Form

Teacher's name: _____   **Date:** _____

[Students]	1. Are you satisfied with the students' classroom performance in this lesson? Why?
	2. What do you hope students should gain and master in this lesson? Did the students understand all of that?
	3. Did the students finish the lesson contents as your planned? Why or why not?
	4. What were the hardest problems to answer in this lesson? Did they finish the expected tasks?
	5. Did all students participate in the SOLE lesson?
[Lesson Objectives]	6. How about the task completion rate toward your teaching goals?
	7. What do you think of those questions you designed? Did these questions keep the students engaged in the lesson?

	8. Were these questions too easy or too difficult for the students?
	9. Is there anything that needs improvement next time?
[Classroom Management]	10. Did you intervene too much in this SOLE lesson?
	11. Did you create an atmosphere of friendly communication and collaboration for students?
	12. Was this lesson completed at a reasonable pace?
[Teacher]	13. Did you respect students' dynamic participation in the SOLE?
	14. How did you deal with the problems that came up during this SOLE lesson?
	15. Were you perceptive and sensitive to each of the students' needs?
	16. Did you allow the students to discover themselves without being embarrassed of lacking knowledge?
	17. How was your attitude throughout class?
	18. How can you do it better next time?
[Other Notes]	

Example of completed forms：
History teacher A
Date: 29.05.2015

[Students]	1. Are you satisfied with the students' classroom performance in this lesson? Why? "Yes, I was delighted with the performance of my students. They were active in class, and they could complete their tasks without my help."
	2. What do you hope students should gain and master in this lesson? Did the students understand all of that? "First, I expected that they could evaluate Deng Jiaxian and Yuan Longping from the development viewpoint and by stages, should not simply be either good or bad, but be carried out through various perspectives. Moreover, I hoped they could remember those milestones in 1960, 1964, 1967, and 1970, because this information is key points in their exams."
	3. Did the students finish the lesson contents as your planned? Why or why not? "According to their discussion, I thought they completed all tasks as I panned."
	4. What were the hardest problems to answer in this lesson? Did they finish the expected tasks? "Question two. I knew it was a little difficult to summarise those important events from discrete periods of time. In the traditional class, I always guided students to underline the keywords on the book, and the answers were clear at a glance. However, in a SOLE, students had to filter important and useful information from various Internet resources. I think they did a good job, better than I anticipated. Although some of them did not give me an accurate answer, I guess they've got the right answer from other groups when they shared their answers."

	5. Did all students participate in the SOLE lesson? "I'm not sure, but I think so. According to my observation, most of students got into groups with their friends, and they could collaborate efficiently with their respective responsibilities'.
[Lesson Objectives]	6. How about the task completion rate toward your teaching goals? "When they shared their answers in the last ten minutes, I asked them if they completed all questions, and all groups told me they completed tasks."
	7. What do you think of those questions you designed? Did these questions keep the students engaged in the lesson? "I designed these questions followed the general teaching syllabus, and all students should master these questions after the class. I think Internet resources facilitated students' engagement in studying. I'm satisfied with their learning attitude."
	8. Were these questions too easy or too difficult for the students? "Moderate."
	9. Is there anything that needs improvement next time? N/A.
[Classroom Management]	10. Did you intervene too much in this SOLE lesson? "No. In this class I didn't provide any help."
	11. Did you create an atmosphere of friendly communication and collaboration for students? "Yes. I didn't intervene in their discussion, and I was largely invisible during the session. The class seemed to be relaxed and lively."
	12. Was this lesson completed at a reasonable pace? "Yes, as usual, they had around ten minutes to share their answers and experiences."

	13. Did you respect students' dynamic participation in the SOLE? "Yes."
	14. How did you deal with the problems that came up during this SOLE lesson? "No particular problem in this session."
	15. Were you perceptive and sensitive to each of the students' needs? "There were eleven groups in this class, I walked around the classroom and listened to their discussion, I could judge which question was not easy for them, so I paid special attention to these questions when they shared their answers in the last ten minutes. I couldn't give consideration to all of them, but I could be the first to respond to their need."
[Teacher]	16. Did you allow the students to discover themselves without being embarrassed of lacking knowledge? "Yes, as usual. In a SOLE, classroom atmosphere may directly influence students' interest in learning. They've gradually understood how to construct their knowledge with their group members together. I think they enjoyed the learning process."
	17. How was your attitude throughout class? "I was fine with this class because they completed all tasks with high quality. I think they've improved a lot compared to several months ago."
	18. How can you do it better next time? "As planned this was last SOLE class in this semester. If in the future students have opportunities to learn history in a SOLE, I'll prepare appropriate questions to them, give students enough time in class to find the answers, and praise their work and encourage them to think about what they did well. I'll provide my help when they need to intervene. I'll motivate them to solve problems by themselves."

[Other Notes]	'Through network-based learning in the SOLEs, students' learning initiative had been promoted. In the conventional classroom teaching, it was a common phenomenon that teachers raised questions while students answered them, which was regarded as the only mode of classroom questioning. This is a limitation to foster student's capability of practice." "It's a pleasure doing work with you, and I believe both of us benefit a lot from these classes. We could keep in touch and I'll tell you our new experiences in the SOLEs. Wish you succeed in your studying!"

Example of completed forms:
Maths teacher B
Date: 27.05.2015

[Students]	1. Are you satisfied with the students' classroom performance in this lesson? Why? "No. Most of groups didn't complete their tasks."
	2. What do you hope students should gain and master in this lesson? Did the students understand all of that? "Linear function is not easy to understand. I was hoping to see that they could at least solve three questions in the class, but only six groups met my expectations."
	3. Did the students finish the lesson contents as your planned? Why or why not? "No. I posed five questions in this class. Some students asked for help because they said they didn't know how to calculate them. Students should understand the connections between each step of the problem so that they could think their way through them. However, Internet resources lacked solving steps, and it made them confused."
	4. What were the hardest problems to answer in this lesson? Did they finish the expected tasks? "Question four and five were a little complex. They have performed below my expectations."

	5. Did all students participate in the SOLE lesson?
	"I knew most of students tried to participate in the SOLE lesson, but they remained in a negative state '.
[Lesson Objectives]	6. How about the task completion rate toward your teaching goals?
	"Not very well. When I asked them to share their answers, most of them told me they didn't solve all questions. This result did not achieve my objectives".
	7. What do you think of those questions you designed? Did these questions keep the students engaged in the lesson?
	"Normally, according to the teaching plan, students should master these five questions after this class, but it seemed that students did not enjoy their learning in the SOLE. Their efficiency of the study was very poor."
	8. Were these questions too easy or too difficult for the students?
	"These questions were easy to non-SOLE group but difficult to this SOLE group."
	9. Is there anything that needs improvement next time?
	"This was our last SOLE class. At present, I was not going to encourage students to learn algebra in the SOLEs."
[Classroom Management]	10. Did you intervene too much in this SOLE lesson?
	"Yes. Students asked for help, so I had to do it."
	11. Did you create an atmosphere of friendly communication and collaboration for students?
	"I did. I provided a comfortable and relaxing atmosphere for their discussion, but I wonder what they will think."
	12. Was this lesson completed at a reasonable pace? "The whole class was controlled within one hour, but they didn't complete all tasks."

[Teacher]	13. Did you respect students' dynamic participation in the SOLE? "Always."
	14. How did you deal with the problems that came up during this SOLE lesson? "I offered my help when they needed, but I think it's not enough. I still think that students should learn algebra through the traditional way, and we can save our time and energy."
	15. Were you perceptive and sensitive to each of the students' needs? "I'm not sure."
	16. Did you allow the students to discover themselves without being embarrassed of lacking knowledge? "I was more than willing to do so, but I didn't know what they were thinking."
	17. How was your attitude throughout class? "When students could solve problems by themselves, I was happy with that. However, in this SOLE class, their performance was not up to the standard, I was a little disappointed."
	18. How can you do it better next time? "I don't have such a plan yet."
[Other Notes]	"Students' learning in this SOLE class was behind eighth-grade schedule. I have to guide them to do more exercises to catch up with the progress. I was anxious for their final examination."

Appendix G

Questionnaire regarding parents' opinions at the end of the SOLE experiment
Date: 29/05/2015

Thank you for kindly participating in this questionnaire. This questionnaire aims to know your opinion on the SOLE.
It should take about fifteen minutes of your time. The questionnaire is anonymous, and your responses are voluntary and will be confidential. The information provided by you will be only used by Xueting Ma for her doctoral research and not for any commercial activity. If there are items you do not feel comfortable answering, please skip them.

If you have any questions or concerns, please contact the researcher Xueting Ma,
Email: X.ma2@ncl.ac.uk, Tel: 13139079728.
Thank you so much for your cooperation and help!

1. Are you willing to encourage your child keep using the SOLE method for history lesson?
A. Very high   B. High   C. Neutral   D. Low   E. Very low

2. Do you think the SOLE method is an efficient learning method for history lesson?
A. Effective   B. Uncertain   C. Ineffective

3. Are you willing to encourage your child to keep using the SOLE method for maths lesson - Plane geometry?
A. Very high   B. High   C. Neutral   D. Low   E. Very low

4. Are you willing to encourage your child to keep using the SOLE method for maths lesson - Algebra?
A. Very high   B. High   C. Neutral   D. Low   E. Very low

5. Do you think the SOLE method is an efficient learning method for maths lesson- plane geometry?
A. Effective   B. Uncertain   C. Ineffective

6. Do you think the SOLE method is an efficient learning method for maths lesson- algebra?
A. Effective   B. Uncertain   C. Ineffective

7. How do you evaluate Self-Organised Learning Environments in the history class?

8. How do you evaluate Self-Organised Learning Environments with maths lesson?

Appendix H

Course observation (Researcher's Field notes)

Date	
Main Discussion Topic	
Students and Groups	
Numbers of laptops	
Questions posed by the teacher	
Classroom observations	**Positive aspects:**
	Negative aspects:
Other Notes	
Feedback	

Example of completed forms:

Date	29.05.2015 (History)
Main Discussion Topic	The Great Scientific and Technical Achievements (1950s-2001)
Students and Groups	57 students; Self-organised into groups; 4-6 students in every group;
Numbers of laptops	16 prepared, 11 used;
Questions posed by the teacher	1. What was the most important contribution from Deng Jiaxian and Yuan Longping? 2. (1) What is the value of the 'Two bombs and one satellite' event? (2) What was happening in 1960, 1964, 1967, and 1970? 3. (1) What was the '863 program'? (2) What specific technological areas were developed by the '863 program'?
Classroom observations	**Positive aspects:** Used keywords; (e.g. technological achievements; agricultural development;) Share answers: almost all groups gave right answers; detailed information; summarised the basic concepts effectively; Teacher A was satisfied with their performance and praised many students today.
	Negative aspects: No.
Other Notes	Questions: 2 minutes; Investigation: 36 minutes; Review: 15 minutes; Six students changed their groups during the task; No intervention No quarrel
Feedback	Diary forms: sent 57, returned 57; Homework: Teacher A was satisfied with it.

Example of completed forms:

Date	27.05.2015　(Maths)
Main Discussion Topic	Application of Linear function
Students and Groups	57 students; Self-organised into groups; 4-6 students in every group;
Numbers of laptops	15 prepared, 11 used;
Questions posed by the teacher	1 and 2: see Appendix D. 3. It is a directly proportional relation between y and x+1, when x=2, then y=1; Calculate, When x=-3, y = _____ It was a little difficult to translate Question 4 and Question 5 into English here. In brief, those two calculation questions were more complicated than above three questions, and they were also relevant to the linear function.
Classroom observations	**Positive aspects:** Three groups completed all tasks without any help. **Negative aspects:** Helpless; confused; Intervention: 7 times; Eight students changed their groups during the task; Most groups didn't complete their tasks; Most students got stuck in negative states; Some groups needed at least ten minutes to solve one question, and the teacher said it took up too much time.
Other Notes	Questions: 1 minute; Investigation: 40 minutes; Review: 15 minutes;
Feedback	Diary forms: sent 57, returned 57; Homework: Teacher A was not satisfied with it;　too many mistakes; the progress of SOLE group lagged behind the non-SOLE group;

Appendix I

Participant Information Sheet
Date: 17/09/2014

Details of the project
·   Name of the project: The application of Self-Organized Learning Environments
·   (SOLEs) in a junior high school in China
·   Researcher's contact details: Miss Xueting Ma
                          x.ma2@ncl.ac.uk
·   If ethical approval has been obtained: Yes, Newcastle University

Purpose of the research
It aims to provide students with more learning opportunities to help students overcome difficulties with the China's examination system, and to investigate whether Chinese teachers and parents can be good mediators when their pupils or children use a SOLE. The ways in which a SOLE can be combined with the opportunities afforded by cloud computing will also be explored.

What is involved in participating?
Research time: First Semester: 09.2014—12.2014
                Second Semester: 03.2015—05.2015

The researcher will choose two subjects as research samples. Considering some subjects in schools are taught once a week or twice a week at most, in order to ensure all subjects can be recorded and repeated at least 20 times during two semesters, the researcher plans to spend around nine months collecting research data. However, this plan may change based on students' weekly curriculum schedule.

The researcher also needs to provide a diary form to participants and invite them to answer some questions about their experiences in SOLEs after each experiment. It also provides an opportunity for participants to ask any questions about the project.

The researcher can make sure maintain the information and records of individuals as confidentiality.

Risk assessment
This research will not induce any physical and psychological stress or discomfort for participants, and the experimental process will not be sensitive in nature. The researcher will not force or compel participants to respond any questions.

Terms for withdrawal

Participants have the right to withdraw at any time without prejudice and without providing a reason.

The notification process for withdrawal will be discussed with stakeholders before collecting data.

Usage of the data

As part of the work for researcher's doctorate, this experiment is only used for personal study, not for any business purpose. The researcher will identify an appropriate file system for long-term preservation of research data. In order to guarantee the data safety, the researcher will back up the data in time. Other researchers will have access to the data only if they agree to preserve the confidentiality of the data, and data will be completely anonymous.

Researcher:

XUETING MA	*XUETING MA.*	17/09/2014
Name of Researcher	Signature	Date

Appendix J

Informed Consent Form
Date: 17/09/2014

I, the undersigned, confirm that:

1.	I have read and understood the information about the project, as provided in the Information Sheet dated _____.	☐
2.	I have been given the opportunity to ask questions about the project and my participation.	☐
3.	I voluntarily agree to participate in the project.	☐
4.	I understand I can withdraw at any time without giving reasons and that I will not be penalised for withdrawing nor will I be questioned on why I have withdrawn.	☐
5.	The procedures regarding confidentiality have been clearly explained (e.g. use of names, pseudonyms, anonymisation of data, etc.) to me.	☐
6.	If applicable, separate terms of consent for interviews, audio, or other forms of data collection have been explained and provided to me.	☐
7.	The use of the data in research, publications, sharing and archiving has been explained to me.	☐
8.	I understand that other researchers will have access to this data only if they agree to preserve the confidentiality of the data and if they agree to the terms I have specified in this form.	☐
9.	Select only **one** of the following: • I would like my name used and understand what I have said or written as part of this study will be used in reports, publications and other research outputs so that anything I have contributed to this project can be recognised.	☐
	outputs so that anything I have contributed to this project can be recognised. • I do not want my name used in this project.	☐
10.	I, along with the Researcher, agree to sign and date this informed consent form.	☐

Participant:

_____ _____ _____
Name of Participant   Signature   Date

Researcher:

___XUETING MA____   _XUETING MA._   17/09/2014
Name of Researcher   Signature   Date

Appendix K

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