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How is EdTech made? An investigation of practitioners' constructions of EdTech in Chinese EdTech companies

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Abstract

This study explores the diverse understandings, beliefs, and practices of EdTech in China through the analysis of 15 interviews with EdTech practitioners. Drawing on the social construction of technology (SCOT), the study investigates the construction of EdTech, providing a means with which to examine and critically assess the likely social and educational implications of EdTech. This study demonstrates the underlying mechanisms by which the economic and political factors influence the construction of EdTech. In particular, this study examines the impact of China's policies of reducing the educational burden on students in 2021 (called "double reduction policy") on the future construction of EdTech.

Specifically, this study provides an in-depth insight into EdTech practitioners in China, uncovering the dominant narrative of practitioners' understandings and beliefs about EdTech, and exposing the internal heterogeneity of the group. The study then investigates the economic shaping of EdTech in China with a number of first-hand examples from the industry, revealing the underlying mechanisms by which business, profit, markets, and capital shape EdTech. Finally, the study understands the mechanisms of political shaping of EdTech by studying the impact of the double reduction policy as an example.

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Chapter 1 Introduction

1.1 Background

Cutting-edge information and communication technologies (ICT), including artificial intelligence, big data analytics, cloud computing, and the Internet of Things have dramatically reshaped the social production and consumption process over the past few decades, improving people's daily experience and efficiency. New business models supported by new technologies continue to emerge in the technology sector, resulting in many powerful technology companies. For example, Google transformed the way information is retrieved and disseminated through search engine, Amazon transformed the way people shop and buy, and Uber changed the way people travel. The ability of technology to disruptively transform the world has become a typical and widely recognised narrative known as the Silicon Valley paradigm, which provides such a powerful narrative that it has dominated thinking far beyond the realm of technology (Weller, 2015). Just as people believe that digital wallet are easily disrupting the traditional payment methods (Birnbaum, 2005), people are also willing to believe that the digitisation of education will create new markets and disrupt the existing education system.

Technological determinism, as the basis of the Silicon Valley narrative, shapes the understandings and beliefs of EdTech globally. It incorporates the following perspectives: firstly, the technological fix to many social problems is possible; secondly, external forces will disruptively change the existing sector; and finally, solutions will be provided by the business sector (Weller, 2015). For the past decades, education has been perceived as slow, archaic, resistant to change, and minimally digitalised, it is therefore considered appropriate for disruption based on the belief of technological determinism (Carmody, 2009) and the narrative on the "broken education" has also inspired lots of interest in the transforming of education (Williamson, 2020).

Especially during the Covid-19 epidemic, as schools were closed during the epidemic, all students around the world had to rely on the internet, conferencing software and some educational technology (EdTech) to complete their studies at home during lockdown. The demand for remote education emerged across the world. All technology giants and EdTech start-ups have seized the opportunity to launch a wide range of user-facing EdTech products and services. The private sector began to lead the development of EdTech in addition to non-profit and public sector provisions (Williamson & Hogan, 2020). Research And Markets

estimates that the global market for EdTech will increase from $250 billion in 2021 to over $600 billion by 2027, a compound annual growth rate of over 15% (Research and Markets, 2021). It is fair to say that the epidemic has made EdTech popular, and it has become an artefact that every learner has to be familiar with.

As a result, the EdTech industry attracted the attention of investors and become a popular industry in the capital market. Venture capital and private equity investors are pouring money into the private EdTech companies because they see the huge potential for growth of the EdTech industry. Brighteye Ventures, an education-focused venture capital, estimates that the amount of money raised by EdTech companies increased six times from 2014 to 2021 (from $3.4bn to $20.1bn) (The Brighteye, 2022). According to HolonIQ, 15 new EdTech unicorns were emerging from 2015 to 2020, compared with 17 new EdTech unicorns in 2021 (HolonIQ, 2022). EdTech has become the focus of attention in the capital markets.

However, beyond inspiring widespread excitement among educational entrepreneurs, the development of EdTech has also sparked widespread anxiety in society and academia as people attach more importance to privacy protection and get aware of the unequal power of giant Internet platforms (e.g., Heeks & Shekhar, 2019; Srnicek, 2017; Zuboff, 2019). In the past, technology was often considered neutral by policymakers and was believed that it could empower education to solve growing social problems by improving teaching and learning, developing students with skills, and enhancing the democracy of education within society (Pring, 2007). However, some critical studies have not only found a large discrepancy between the promise of EdTech and the actual delivery of improvements (Selwyn, 2016b), but also that the boom in online learning may further improve the development of platform capitalism, meaning “the fundamental foundations of the economy are rapidly being carved up among a small number of monopolistic platforms” (Srnicek, 2017, p.58). The deep binding of commercial interests and EdTech may lead to learners falling into an unequal power relationship. Based on this, many scholars have questioned the determinism and solutionism of EdTech (Teräs et al., 2020).

In addition, the unique nature of the EdTech industry makes the EdTech research even more important: EdTech mainly aims at children and young people. They are often considered to be in the process of shaping their world view and values and are more sensitive to instruction and discipline from outside. As the digitalisation of education continues to improve, young learners usually have no choice but to embrace new technologies. For example, once a school decides

to use Microsoft Teams for online classes during the pandemic, even if the students are uncomfortable with the data collection and user interaction, the students do not have the freedom to make choices but have to accept the new technology passively. Imbalanced power relations often exist during the expansion of technology in education. It is therefore necessary to study the private EdTech that has already occupied the market.

The study of EdTech can be approached from a number of perspectives, for example, applying Bijker's (2010, p.63) arguments to EdTech from a philosophical and ontological perspective on "what is EdTech", from a political perspective on "how to use EdTech" and from an academic perspective on "How to study EdTech". EdTech is an emerging concept that has grown drastically in recent decades. Current research usually focus on the impact EdTech may have on learners (e.g., Heeks & Shekhar, 2019; Rafalow & Puckett, n.d.; Selwyn, 2019). Apart from the impact of EdTech, the process of EdTech's origin, design, and production is also of great importance because only by understanding the process of the construction of EdTech can we gain a better understanding of its implications. However, there is less research into "how is EdTech made" right now. Therefore, this study focuses on the question of "how is EdTech made" to explore the construction of EdTech.

To answer the question of "how is EdTech made", technology is seen as an artefact that is culturally constructed and interpreted, with social, economic, and political factors shaping narratives and values, which in turn influence and give meaning to artefacts (Pinch & Bijker, 1984). This study applies the theoretical framework of social construction of technology (SCOT) in order to understand how the construction of EdTech in the private sector is influenced by economic and political factors. As Pinch & Bijker (1984) argues, people's ideas and interpretations of artefacts have "interpretative flexibility", so people have "design flexibility" with technology. The design process of technology is a "open process that can produce different outcomes depending on the social circumstances of development" (Klein & Kleinman, 2002, p.29). In order to explore the construction of EdTech in the private sector, EdTech practitioners are chosen as the subjects of this study. EdTech practitioners refer to employees in the EdTech industry who are responsible for the design, developing, production, and delivery of EdTech. They are the people who have "interpretative flexibility", "design flexibility", and power over the construction of EdTech. Therefore, research on EdTech practitioners is an effective way to understand the construction of EdTech in the private sector.

Why is China chosen for this study? Firstly, EdTech has been in China for a long time. It first originated from electrifying education (Nan, 2003), which was introduced in the 1930s based on the use of slides, films and radio for educational communication. Electrifying education refers to the use of modern educational media, which is combined with traditional media, to deliver educational information in order to optimise education (Nan, 2003). In the 21st century, modern EdTech, marked by information and communication technology (ICT), gained importance and electrifying education has been transformed into education informatisation in China.

Secondly, in the last decade, EdTech in the private sector in China has made rapid progress, generating widespread interest worldwide. Due to supportive central government policies and fast-growing entrepreneurial infrastructure support, China's information and communication technology (ICT) has developed rapidly in recent decades and is beginning to attract significant international attention (e.g., Knox, 2020). Taking artificial intelligence (AI) as the example, some scholars even regard China as an emerging international leader in the development of AI (Knox, 2020). In addition, huge consumer market has made China a testing ground for EdTech's innovations, especially after the epidemic. In 2020, the total money amount that China's online education companies raised accounts for 89% of the total education market. The online rate of China's education increased from 9% to 24% in 2020. The market size of the online education increased by 35.5% to 257.3 billion yuan in 2020 (iResearch, 2021). In terms of the number of EdTech start-ups, China accounts for three of the top five EdTech unicorns among global start-ups (HolonIQ, 2022). China has also witnessed the listing of many giant EdTech companies such as New Oriental Group, TAL Education Group, and GSX Techedu. To conclude, China is already a well-deserved global focus in the EdTech sector.

Thirdly, the rapidly changing policy environment makes EdTech in China a worthwhile study. In July 2021, China's State Council and Ministry of Education (MOE) issued the "Guidelines to ease the burden of excessive homework and off-campus tutoring for students undergoing compulsory education" (known as "double reduction policy"). It aims at reducing the burden of homework and extracurricular tutoring on students in compulsory education. It bans all off-campus subject-tutoring for primary and middle school students on weekends and holidays; forces all subject-tutoring institutions to register as non-profit organisations; bans listing and financing of tutoring institutions and the entry of foreign capital into the education sector in China; and bans any forms of advertising for tutoring institutions (MOE, 2021). Although online subject tutoring is only one part of the EdTech sector, it is currently the main business

of most Chinese EdTech companies and one of the few education business models that have proven its profitability. Following this, almost all Chinese online education companies have shut down their K-9 tutoring business and moved to other education sectors such as vocational education, educational smart hardware, arts education, and learning management system (LMS). The share prices of New Oriental Group and TAL Education Group fell by more than 74% after the policy announcement (Neiger, 2021). Despite the lack of an official explanation, it is widely believed that the double reduction policy is intended to prevent the uncontrolled expansion of capital in the education sector in China, and to reduce students' academic burden and anxiety. Some literature suggests that the double reduction policy is in line with China's long-standing policy of reducing the burden of education on students. Xiang (2019) contends that reducing the burden of education has been one of the key directions of China's education policy since 1955, and there have been several rounds of burden reduction policies implemented throughout the history of China. Beginning with the MOE's "Instruction on Reducing the Excessive Burden of Students in Primary and Secondary Schools" in 1955 and Spring Festival talk on the "Education Revolution" in 1964, the imbalance in the structure of educational resources and the concentration of prominent schools led to an excessive burden on education (Xiang, 2019). This round of double reduction policy will significantly affect the future development of EdTech in the private sector in China (Daniel, 2021). Therefore, the double reduction policy here can be seen as a typical example of the changing political environment in the EdTech industry, with far-reaching implications for the shaping of future EdTech in China. As a new policy that is destined to have a huge impact on education, there is relatively little research on its causes and effects, so it is valuable to examine the political shaping of EdTech using the double reduction policy as an example.

In addition to the double reduction policy, the Chinese government has also enacted a large number of policies to support the digital development of education. For example, the State Council released the "National Strategy for AI Development" in 2017, which supports the development of intelligent education, the use of intelligent technology to accelerate the reform of talent training and teaching methods, and the construction of a new education system that includes intelligent learning and interactive learning (State Council, 2017). The MOE released the "Education Digitalisation 2.0 Action Plan" in 2018 (MOE, 2018), and the State Council released the "Education Modernisation 2035" in 2019 (State Council, 2019). These policies will have a significant impact on the development of EdTech in China. Overall, China's stage of development with its unique economic and political conditions will provide an essential

reference for research on the social construction of EdTech in the private sector in the world. That's the reason why China is chosen as the example in this study.

This dissertation consists of six chapters. The first chapter has provided an introduction to the study, in which I present the necessity for the study, introduce the background information on relevant concepts, including China contexts and related policies, and describe the purpose and contribution of the study. Chapter 2 provides a literature review on the relevant concepts in this research to structure the three research questions. Chapter 3 describes the methodology adopted in this research. Chapter 4 shows the findings, and Chapter 5 discusses them. Finally, Chapter 6 concludes the whole project and provides future implications.

1.2 Purpose

This study focuses on practitioners in EdTech companies in China through interviews and draws on the social construction of technology (SCOT) to illuminate the diverse understandings, beliefs, and practices around EdTech in China. It takes an in-depth perspective to explore the economic and political factors impacting the construction of technology as a means with which to critically assess the likely possible social and educational implications of EdTech. In particular, this study examines the impact of the double reduction policy on the beliefs of EdTech practitioners and the future construction of EdTech in China. The three research questions that will be answered in this study is what the understandings and beliefs of EdTech for Chinese EdTech practitioners are, how economic considerations influence the construction of EdTech in private sector, and how the double reduction policy impact practitioners' beliefs and the future construction of EdTech in China. The research questions will be fully justified in chapter 2.

1.3 Contribution

This study contributes to the literature in the following ways.

First, this study illuminates the construction of EdTech through an investigation of EdTech practitioners to help understand the possible social and educational implications of EdTech. EdTech practitioners are stakeholders who have the power to define and shape technology, and their understandings and beliefs directly influence the design and production of technology. Direct and in-depth research into them and their political economic environment help us understand EdTech clearly. Past research on the shaping of technology has rarely included a

direct investigation of practitioners' experience and insights. This study examines the shaping of EdTech from a direct and unprecedented approach.

Second, this study greatly complements the literature on the social construction of technology (SCOT) in China. Due to the differences in technological culture, business practices and educational beliefs between China and western countries, western theories of SCOT may not be entirely applicable in China. Research and literature on SCOT in China is relatively limited and this paper takes EdTech as an example to complement the research on SCOT in China. It will also contribute to the literature on the double reduction policy as the few papers that have attempted to understand its reasoning and impact as well.

Chapter 2 Literature Review

2.1 Educational technology (EdTech)

2.1.1 What is EdTech?

Educational technology (EdTech) is a term that is currently in vogue, along with similar concepts such as learning technology, instructional technology, and training technology, which are often used with the same meaning. Rushby & Surry (2016, p.4) preferred using "learning technology" because it is considered to avoid separation between training and education. This study follows the phrase of "EdTech", which is commonly used in the private sector and capital markets (Research and Markets, 2021). In this section, let's discuss the definitions of EdTech, education, and technology, the specific range of technologies that EdTech encompass, and the history of EdTech.

EdTech is typically a term of pluralist interpretation, with each scholar, practitioner, and user having a unique understanding of it (Rushby & Surry, 2016). A relatively consensual definition of EdTech comes from the Association for Educational Communications and Technology (AECT), which defines EdTech as "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" (Januszewski & Molenda, 2013, p.283). Spector (2015, p.10) has a similar definition: "educational technology involves the disciplined application of knowledge for the purpose of improving learning, instruction, and/or performance". By analysing the AECT's definition of EdTech, Hlynka & Jacobsen (2009) identifies four features of EdTech: EdTech is a research and practice which rejects the dominant ideological focus on the instrumental nature of technology; the purpose of EdTech is to facilitate learning and improve performance; the separation of creation, using, and management implies different roles in EdTech; EdTech is not just a collection and application of information and communications technology (ICT), but also includes related books, videos, solutions, and services. These definitions and perspectives help us to understand the emerging concept of EdTech.

To better understand EdTech as an interdisciplinary combination of education and technology, a review of the two concepts is presented. First, what is education? The understanding of education in academia varies greatly, with Chazan (2022) arguing that education is a purposeful activity aimed at achieving certain objectives, in particular the dissemination of knowledge, Chinese education textbooks defining education as the practice of promoting the socialisation

of the individual and the individualisation in the society that takes place in a certain social context (Pang, 2015). Learning is a word that comes up a lot when discussing education. From the perspective of behaviourist scholars, learning is a process that leads to changes in individual behaviour as a result of personal experience (Rushby & Surry, 2016), while Bruner (2020) claims that learning is the process by which a person figures out himself and develops an understanding of the world. Obviously, we should recognise the complexity of education. Education is not just a technical problem of facilitating individual learning but is also embedded in a wide range of political, economic, and social factors and contexts. We need to understand that the act of learning is intertwined with many factors in social life, such as the game of political and economic forces in schools, governments, and business organisations in educational settings. This leads to different understandings of education and helps to portray the concept of education in a broad social context.

What is technology? Technology is often thought of as "the process by which humans modify nature to meet their needs and wants" (Rushby & Surry, 2016, p.4). Over two million years ago, humans began using technology to improve living conditions by building simple tools to obtain life-supporting resources. The purposefulness of enhancing living conditions means that technology is not just an artefact. As Teich (1997) argues technology is more than just machines, the social contexts and conditions in which technology is used should also be discussed. MacKenzie & Wajcman (1999) identifies three perspectives on technology, namely physical objects themselves, human activities around the physical objects, and human knowledge around activities. Take the Internet as an example, no one agrees that the Internet is made of fibre optics, keyboards, and chips, but rather that people's activities on the Internet and the knowledge they construct tend to attract more attention. Livingstone & Lievrouw (2006) proposes three factors to conceptualise technology from a social and technological perspective, namely artefacts and devices, activities and practices, and context. These ideas summarise well the question of what education and technology are and show that it's important to view EdTech with social realities and social contexts, which goes beyond the understanding of education and technology as artefacts. Selwyn (2016a) contends that EdTech is intrinsically linked to social, cultural, economic, and political factors as the combination of education and technology. Rushby & Surry (2016) argues that the focus of learning technology should be on learning and learner, rather than on the technology as the artefact. We should therefore understand EdTech both in practice and in context.

What specific technologies are now available in EdTech? Based on computer technology, multimedia technology, virtual reality, artificial intelligence and other technologies, the field of EdTech has produced Massive Open Online Courses (MOOCs), learning analytics, emotional and facial recognition, distance learning, user modelling, adaptive learning, and a variety of other educational technologies (Rushby & Surry, 2016). It is important to note that EdTech does not only refer to new technologies of ICT and digital technologies, but also includes technologies such as projections, films, radio, television, and other traditional media. This study mainly focuses on educational technologies supported by ICT technologies, with the characteristic of mass socialisation of internet connectivity and activities (Selwyn, 2016a).

In terms of the history of EdTech, tools such as the abacus and blackboard have been used for over a thousand years while slides and instructional films have been widely used for teaching since the 1950s. These can be considered as applications of EdTech in a broad sense (Saettler, 2004). Online education began at the University of Illinois since the 1960s. Although there was no Internet until a decade later, students could access classes via connected computers at that time (Saettler, 2004). In the mid-1980s, digital and Internet communication began to develop, and educational institutions began to adopt new media to deliver distance learning courses. As the internet infrastructure continued to develop, MOOCs became one of the buzzwords of the year in 2012 (Weller, 2018). Due to the Covid-19 pandemic, 2020 saw an unprecedented increase in the number of students participating in distance learning as schools were forced to close worldwide. In 2020, the US EdTech start-up raised $1.78 billion in venture capital through 265 deals, compared to $1.32 billion in 2019 (Kaplan, 2021). The social, academic, and business attention to EdTech has reached a peak since then.

In this section I have reviewed the definitions of education, technology, and EdTech, and have talked about specific examples and history of EdTech. This study uses the AECT definition of EdTech, which is “the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources”. In terms of specific technologies, this study mainly focuses on the emerging ICT-enabled EdTech to understand the more cutting-edge and currently under-researched area of EdTech.

2.1.2 EdTech in private sector

As mentioned in section 2.1.1, the privatisation and commercialisation of EdTech is increasing these years. Typically, the players and stakeholders in EdTech are educational companies and

start-ups, government, university research departments, technology companies, non-profit organisations, investors, and other financing institutions (Williamson & Hogan, 2020). Ball (2012) argues that the expansion of private sector comes from the outsourcing of government in education and the increase in public-private partnerships. Private sector players were given the opportunity to participate in rebuilding the public education infrastructure and therefore the business of education expanded rapidly. Williamson and Hogan (2020) argues that the following new features have emerged in the private EdTech sector: the joint provision of education by the non-profit and profit sectors; profit as the main motivation for most private sector and some non-profit sector involvement in education; financial market support; and frequent mergers and acquisitions between education companies and organisations.

Riep (2019) expresses concern about the new trend, arguing that the private sector can decide on solutions to education problems in a way that is beneficial to itself and its shareholders. Market mechanisms insert the interests of the private sector into areas that are otherwise public provision (Reckhow, 2012). The trend towards privatisation (mainly referring to the paradigm shift in the provision of education through the introduction of market mechanisms) and commercialisation (mainly referring to participants profiting from the commodification of education) in the field of EdTech has generated debate and concern. A range of social and economic contexts has been embedded in EdTech, affecting its construction and practices.

It is therefore essential to understand the economic factors, commercial interests, and market mechanisms behind EdTech's practice and experience in the private sector. This helps us to understand how increasingly commercialised and privatised education systems are designed and produced within market mechanisms and ultimately what the social and educational implications will be.

2.1.3 Criticism against EdTech

The emergence of EdTech is seen as a promising solution to some of the most challenging educational problems in society by policymakers, such as the high cost of education and the lack of resources, the difficulty of personalising education, the efficiency problem of the education system, and the inequalities caused by the over-concentration of educational resources (Rodriguez-Segura, 2021). As a result, EdTech got abundant investment because it is generally believed that technology could make education better and make a profit for companies (Selwyn, 2016b). But in recent years, EdTech has also begun to be questioned by the academia (e.g., Edwards & Cheok, 2018; Friesen & Lowe, 2012; Selwyn, 2019).

Taking MOOCs and educational equity as an example, MOOCs are seen as a promising solution for making access to education more equitable (Lambert, 2020). Pappano (2012) argues that "the shimmery hope is that free courses can bring the best education in the world to the most remote corners of the planet". However, it is shown that MOOCs have very little impact on educational equity because although most developing countries offer MOOCs, only the privileged class benefit from MOOCs (Lambert, 2020). It is because people with higher socio-economic status know how to make better use of new educational resources. Much of the literature has also found that the provision of and investment in MOOCs expands the digital divide, that is to say, expands the gap between rich and poor (Laurillard & Kennedy, 2017; Rohs & Ganz, 2015). Rodriguez-Segura (2021) argues that it is the differences in the penetration of technology between different socio-economic classes hinder the application of EdTech, leading to inequalities within and between countries. MOOCs were born with high hopes of addressing educational equity but have ultimately been shown to widen educational inequity instead.

Some literature also focuses on the issue of data ownership and control brought by EdTech that has resulted in inequalities for marginalised groups. In "The Age of Surveillance Capitalism", Zuboff (2019) describes how Google continues to collect data and capture the user behaviour surplus in order to attract more users. Manovich (2011) claims that the power of experts has reached its peak in the digital age, with data scientists able to influence social life through data collection and analysis. The average learners usually have no way of understanding the complex digital operations involved and have no choice but agree and accept it.

Researchers have also found that EdTech lead to more prejudice and discrimination. Gillborn et al. (2018) found that university admissions data software discriminates against women and students with non-European-sounding names. Rahman (2020) noted that these biases come from the way the algorithms designed with the goal of commercial interest. Winters et al. (2020) argue that the use of digital technology in education leaves some disadvantaged learners trapped in digital structural violence. In addition, there are increasingly widespread concerns about data security and privacy issues in EdTech. Digital platforms can track, store, and analyse learner behaviour, but there is also a risk of data misuse (Spector, 2001).

To conclude, with the popularity of EdTech, the critiques including the concern with the unequal power of large platforms, the increasing awareness of data and privacy protection, and the potential prejudice and discrimination have begun to grow. It means that the study of

EdTech in the private sector is essential. We can generate rules and regulations that can counter these negative effects by understanding how they are designed and constructed in a social context. This is necessary for a better understanding and construction of EdTech in the future, so that students can avoid the harms and benefit from it.

2.2 Social construction of technology (SCOT)

Before discussing the relationship between social factors and technology and reviewing social construction of technology (SCOT), it is important to understand technological determinism first. Technology is an essential part of society. It supports the production of food, clothing, transporting, and housing, and is inseparably embedded in social life. When the relationship between technology and society is discussed in the field of Science, Technology and Society (STS), an important view is technological determinism (Oliver, 2011). Technological determinism is constructed around two main ideas: society does not influence technology, which needs to evolve and progress scientifically on its own; and technology influences society (Oliver, 2011). The famous example of the first idea is Moore's Law, a rule that has driven the revolution in ICT in the past decades. Moore's law states that the law of chip development is the same as the laws of nature and the number of transistors that can be accommodated on an integrated circuit doubles every 18 months (Moore, 1975). It means that society does not have an impact on technology and that technological change is a natural law. The second idea suggests that technology shapes society in some way, including social practices (Jones, 2001). For example, technology has been massively purchased by governments and schools for decades because it is assumed to improve learning outcomes and teaching effectiveness (CUBAN, 2009). People are willing to invest in EdTech because people believe that technology can change society.

However, there are many critiques about technological determinism. For example, technological determinism has no way of explaining how technology is shaped. MacKenzie & Wajcman (1999) argue that technological determinism cannot explain the features of technology because it is not considered to be important at all. Moreover, technological determinism complies with the assumption of technological neutrality, which hides the shaping of technology by social factors (Oliver, 2011). Winner (1993) began to break down the assumption of technological neutrality. He argues that technology was political, and that people could consciously design technology to control some social practices. This marked the beginning of the emergence of different views on technology and society.

Social construction of technology (SCOT) offers a new perspective in the relationship of technology and society, which, in contrast to technological determinism, argues that social activity shapes technology and emphasises the importance of social context that technology embedded in (MacKenzie & Wajcman, 1999). SCOT can be traced back as far as Pinch and Bijker's (1984) article. They summarise four relevant components of SCOT, namely interpretive flexibility, relevant social group, closure and stabilisation, and wider context. Interpretive flexibility means that technology design is an open process that produces different results depending on the social context. Relevant social group is reflected in the fact that "all members of a certain social group share the same set of meanings, attached to a specific artefact", therefore different social groups will construct different results. Closure and stabilisation refer to the flexibility of interpretation leading to controversies in the design process, which takes some time until a compromise is reached. Wider context refers to the broad socio-cultural and political environment in which artefact development takes place.

SCOT does not ignore the impact of technology on people and their behaviour, but also emphases the intentionality of technology and draws attention to the socio-cultural and political-economic factors surrounding technology. In EdTech companies, social, cultural, economic, and political factors shape the company's culture and the values of the practitioners, who provide EdTech to learners through their definition and production of technology. Therefore, it is necessary to understand how technology is embedded in a social context to understand how technology is designed.

Taking economic shaping of technology as one example, MacKenzie & Wajcman (1999) discusses the mechanisms of the economic shaping. When economics is mentioned, the concepts of reducing costs and increasing revenues are often involved. MacKenzie & Wajcman (1999) used the example of Edison as the example to show the process of economic factors shaping of technology. Edison, who invented the light bulb, was a technical designer with an intention to generate electricity and sell the product to consumers. He had to keep costs as low as possible, not just because shareholders wanted to make a profit, but also to survive in market competition with gas. Therefore, he offered electric lamps at the same price as gas lamps. These economic calculations directly influenced the following research and design process of the light bulb (MacKenzie & Wajcman, 1999). The current dominant way of thinking about the link between economics and technology is neoclassicalism, which assumes that firms make rational decisions by choosing the technology that offers the most profit (Frank, 2013). Therefore, social factors influence technological change by shaping the market framework.

There is a few more literature that uses SCOT perspective to examine Artificial Intelligent (AI) in education. Eynon and Young (2021) explores how differences in definitions of AI between academia, industry, and government in educational contexts affect the way AI is designed and used in lifelong learning. They argue that AI is a "complex social, cultural, and material artefact that is understood and constructed by different stakeholders in varied ways" (Eynon & Young, 2021, p.166). Exploring these differences allows for the exploration of the potential social and educational implications of AI.

In conclusion, SCOT offers a fresh perspective on the relationship between technology and society. And social shaping of EdTech would be a meaningful study because EdTech is one of the most important areas of technology that has yet to be fully studied from the construction perspective.

2.3 Political economy of EdTech

In the section 2.1 and 2.2, I have covered the topic of economic and political environment of EdTech. Mosco (2009, p.4) put it, "the political economist asks: how are power and wealth related and how are these in turn connected to cultural and social life". It shows that political economy is concerned with the processes of production and consumption of technology and how economic and political factors influence these processes, resulting in a unique set of power dynamics. The political economy's emergence in the field of technology is due to the growing realisation that the analysis of technology needs to be complemented by a better understanding of the political and economic context behind it (Regan & Khwaja, 2019). Selwyn (2012) argues that the political economy approach focuses on the functions of government and the role of the commercial participants, the power relations of economic politics and society, and raises direct concerns about the interests of politics and economics in society. Selwyn (2012) also contends that the political economy approach to EdTech intends to document the complex network of competing interests and power that constitutes the production of educational hardware and software.

There is some literature adopting political economy approach to evaluate EdTech. Selwyn (2016b) argues that EdTech's commercial players often promise much but deliver little, and there are many technology companies that fail to properly understand education and engage in education. A great deal of competition in the EdTech industry comes from the fear of falling behind competitors rather than for educational purposes (Schiller, 1999). A case study of Pearson pointed out that large learning platforms are trying to monopolise education data

production and analytics (Williamson, 2021). Regan & Khwaja (2019) uses a network perspective to explain the power dynamics of investment institutions in EdTech. Zeide (2015) summarises the history of EdTech innovation and notes that technology enthusiasts often lack a coherent educational philosophy, relying instead on non-critical beliefs to impose digital education in schools and classrooms. Arndt & Tesar (2018, p.234) contends that educational policies undermine "foundational educational dignity and professionalism, and the established truths on which they are based".

Overall, the intricate economic and political factors behind education and technology have a significant impact on the design and delivery of EdTech. The study and discussion of EdTech from a political economy perspective is an area that is currently new, but very important.

2.4 Research questions

Based on the literature review, there are three research questions in this research. Firstly, based on the theory of social construction of technology (SCOT), it is important to study the perceptions, understandings, beliefs, and practices of EdTech practitioners to better understand the design, production, and delivery process of EdTech. The understandings and beliefs of EdTech practitioners are socially shaped in their daily lives and work, and these understandings and beliefs would influence their practice and shape EdTech fundamentally. Therefore, the first research question is:

RQ1. What are the understandings and beliefs of EdTech for Chinese EdTech practitioners?

Secondly, based on the rapid growth of EdTech, the increasing importance of economic considerations around the construction of EdTech, and the increased concern and criticism against the negative impact of EdTech in the private sector, it is worthwhile to understand the impact of economic factors on the shaping of EdTech. Then, the second research question is:

RQ2. How do economic considerations influence the construction of EdTech in the private sector?

Finally, based on China's unique EdTech policy environment, it is worthwhile to study the impact of political factors on the construction of EdTech. As one of the most important and

far-reaching policies in the field of EdTech in China, the double reduction policy is chosen as the example of the change of policy environment to study the political shaping of EdTech. The study of the double reduction policy as an important policy turning point can not only provide practitioners' experience and insights into this new policy change, but can also help us understand the underlying mechanisms of political factors influencing the shaping of EdTech. Therefore, the third research question is:

RQ3. How does the double reduction policy impact practitioners' beliefs and the future construction of EdTech in China?

Chapter 3 Methodology

3.1 Research design

This chapter will provide the research design and the reason, the choice of methodology, background description of participants, and the ethics concerns of this research. Firstly, a qualitative design with semi-structured interview methods is adopted in this research and the reason why the research method got chosen is discussed. Then, the sampling, data collection, and data analysis methods are provided and evaluated. Some essential issues including sampling methods and interview strategies are discussed and highlighted. Finally, ethical concerns and considerations regarding this study are shown.

To answer the research questions, this study adopted qualitative research design. This is based on the nature of the research questions, which Newman (1994) argues should be considered first when choosing a research method. The research questions for this study stem from the paucity of existing literature on the social construction of technology (SCOT) and political economy of EdTech in China. Primarily, the aim of the research is to investigate the understandings and beliefs of EdTech practitioners in China and therefore explore the processes by which EdTech is shaped socially, economically, and politically. It is rather an open-ended and exploratory research aim in searching for rich descriptive information. Quantitative research is more concerned with measuring objective facts while qualitative methods produce open, non-numerical, descriptive data and the data is analysed in an exploratory and non-statistical way (Newman, 1994). Qualitative methods apply an inductive approach to the relationship between theory and research (Bryman, 2012). In the field of the construction of technology, the relevant theory usually relies on unstructured data to identify problems and explore theories. In particular, qualitative research methods can explore highly complex situations and help to increase the number of possible explanations for practice. This is highly compatible with the intricate political economy environments of EdTech. Therefore, the research question is more suitable for qualitative methods.

3.2 Interview

This study adopted a semi-structured interview as the qualitative research method. Semi-structured interview usually refers to an interview where “researcher has a list of questions or fairly specific topics to be covered, often referred to as an interview guide, but the interviewee has a great deal of leeway in how to reply” (Bryman, 2012, p.471). In contrast to structured

interviews, which have a strict list of questions and do not allow interviewees to shift any focus, semi-structured interviews are generally open-ended and allow interviewees to come up with new ideas based on the topic in the research (Bryman, 2012). This is highly compatible with the research aims of this study. This study encompasses open-ended research questions based on social construction of technology (SCOT), with the aim of understanding the process of the construction of EdTech and exploring the possible social and educational implications of EdTech. The open-ended approach to the interviews allows flexibility to include new topics that might emerge during the conversation. The findings of this study are likely to be beyond the my original understanding and imagination and therefore the flexibility of semi-structured interviews is appropriate. In addition, compared with unstructured interview, semi-structured interviews have the advantage of obtaining more focused information (Bryman, 2012). It is therefore reasonable to use semi-structured interviews in this study.

The use of an interview guide ensures that the content of the interview is focused on a particular topic and does not deviate too much. For the semi-structured interview in this research, an interview guide was prepared (see Appendix 4). Some open-ended questions and topics based on the three research questions were used to structure the interview. In the first research question (understandings and beliefs about EdTech), interviewees were asked primarily about their views on education, technology, EdTech and the relationships among them, and their beliefs in the value of EdTech. In the second research question (economic shaping of EdTech), interviewees were asked about the impact of business considerations on EdTech and its design and production process, and the trade-off between business interests and educational value. In the third research question (political shaping of EdTech), interviewees were asked primarily about the impact of policy on EdTech and practitioners' beliefs. When necessary, I ask follow-up questions to explore, clarify, and develop the topic based on the interviewee's relevant responses. The interview questions were designed in such a way as to allow the interviewee to express their own views, experiences, and insights. The interview guide was not finalised until two pilot interviews, which provided an opportunity to test the interview guide, practice the manner, and optimise the interview questions. The two interviewees in the pilot interviews were colleagues that I have worked with in the past and were responsible for different businesses within the same company. They were responsible for the operational management of the company's subject AI tutoring software for high school students and the teaching and research of the AI education software for primary school students respectively. They all had more than six months' experience within the EdTech industry. They were generally interested

and satisfied with the content of the interviews. After completing the two pilot interviews, I had a brief discussion with the two interviewees respectively and made the following adjustments to the interview guide in order to get a better interview experience and more appropriate interview questions for the topic. First, some unclear expressions have been replaced. For example, “What do you think is the value of technology?” was replaced with “What value do you think technology provides to education?”. It helps to narrow down interviewees’ responses and concentrate on the research topic. Second, the order of some questions that has been shown as unreasonable was reordered. The interview guide was then finalised and used in the subsequent interviews.

Each interview is planned to last approximately 45 minutes. Due to travel restrictions caused by Covid-19, the interviews were conducted entirely online using Tencent Meeting. It is an online conference software that is widely used in China for business, education, and government with a very wide user base. I would like to create an environment that is comfortable for interviewees to ensure unbiased interview results. For most of the EdTech practitioners, their level of digital literary is relatively high and most of them are familiar with the use of Tencent Meeting. Therefore, online interviews do not create potential problems of participant selection bias or cause discomfort for participants. In addition, the interview process is arranged as a gradual process. It means that the interview starts with the interviewee’s work and responsibilities that is familiar for them, which provides the context for the subsequent conversation and also acts as an icebreaker to help the interviewee feel comfortable (Bryman, 2012). The interview then moves on to a more insight-oriented section after factor-based conversations.

3.3 Sampling

This study uses purposive sampling and snowball sampling as sampling methods. Purposive sampling refers to the selection of individuals from the population that are considered to be the most representative based on the researcher’s experience and identification (Newman, 1994). This sampling method can be used when the researcher is familiar with the field of study and has a good understanding of the population (Newman, 1994). I, as the researcher of this study, have experience working as a product manager and operation manager for some Chinese technology and EdTech companies for more than one year. As product managers are often directly responsible for the technology delivered to users and occupy a central position within the technology team (Springer & Miler, 2018), the immersive working experience endorses

the validity of purposive sampling process in this research. In order to obtain a more representative sample, the purposive sampling in this study adopts the idea of stratified purposive sampling. It is designed based on the principle of obtaining a sample that is as dispersed as possible across the basic dimensions of employment status, educational background, degree major, position, and company. Given the constraints of the research cycle and the inevitable problem of under-sampling, five positions within EdTech companies are finally chosen as the research subjects for this study. They are product & operations manager (OP), teacher & teaching assistant (TA), sales & marketing manager (SA), research & development engineer (RD), and strategy & investment manager (SI). The five positions are usually considered to be core business positions within the company and are closer with the process of design, production, and delivery of EdTech. Other positions in the company, such as human resources managers, are not closely associated with EdTech due to the nature of their positions, and their functions are the same in any kind of company and therefore are not included in this study.

In addition, snowball sampling is also applied in this study. During the research, participants were collected from my past colleagues, friends, and LinkedIn recruitment. Participants are also invited to voluntarily refer their colleagues and friends to participate in the study. Snowball sampling is a kind of convenience sample, which is considered to be efficient to find relevant samples, but may compromise the representativeness of the sample (Bryman, 2012). To fix the problem, this research prioritises stratified purposive sampling than snowball sampling, which means that the samples obtained from snowball sampling are screened according to the principles in purposive sampling to decide whether to proceed an interview.

Finally, a representative sample of 15 EdTech practitioners is drawn for this study and the distribution of characteristics and descriptions of interviewees are shown in the Table 1 and 2. As we can see in Table 1, in terms of participants' gender, only two of them are male, because the interviewees selected for this study are mainly frontline employees (not management) in the EdTech industry, a group in which women dominate. In terms of employment status, nine interviewees had left the EdTech industry within six months of being interviewed. This is mainly due to the double reduction policy introduced in July 2021, which has had a significant impact on EdTech industry that almost all companies undertook several rounds of layoffs. In terms of educational background, all practitioners have a bachelor's degree and four of them have a master's degree. In terms of majors studied, three practitioners have majors directly related to education, while the other largest number of majors are business and economics.

Overall, the samples have good representativeness on characteristics of gender, educational background, degree major, and position. In addition to this, as shown in Table 2, the sample covers seven companies and several start-ups, which covers almost all the top companies in the EdTech market in China. In terms of educational segmentation, the sample includes K-12 online education, Learning Management System (LMS), AI learning software, online programming, online art education, online language learning, online continuing education and almost every form of EdTech that exists in the market. Therefore, the sample can be considered valid and representative.

Table 1
Participant descriptive statistics

Item	Frequency	Percentage (%)
Gender		
Male	2	13
Female	13	87
Employment Status		
Employed in EdTech companies	6	40
Left EdTech companies within 6 months	9	60
Educational background		
Master's degree	4	27
Bachelor's degree	11	73
Degree major		
Education related	3	20
Business & Economics	5	33
Science & Engineering	4	27
Arts & Humanities	3	20
Position		
Product & operations manager (OP)	4	27
Teacher & teaching assistant (TA)	6	40
Sales & marketing manager (SA)	2	13
Research & development engineer (RD)	1	7
Strategy & investment manager (SI)	2	13

Table 2
Participant description

Unique identifier	Working experience in EdTech	Employment status	Degree major	Educational background	Position	Company	EdTech segmentation
OP-1	8 months	Left	Literature	Bachelor's	Operation manager	L, B	9-12 AI tutoring
OP-2	2 years	Employed	Film	Bachelor's	Product manager	B	9-12 AI tutoring
OP-3	8 months	Left	Education	Master’s	Operation manager, teaching assistant	B, Start-up	K-9 AI tutoring, language learning
OP-4	1 year	Left	Education	Bachelor's	Product manager	B	K-9 AI tutoring, edu hardware
TA-1	13 years	Employed	Physics	Master’s	Teacher, teaching and research	X, B	Continuing Edu, 9-12 online tutoring
TA-2	3 years	Left	Economics	Bachelor's	Teacher, teaching and research	H	Online language learning
TA-3	11 years	Employed	Material	Bachelor's	Teacher, teaching management	X, Start-up	9-12 online tutoring
TA-4	3 years	Left	Economics	Bachelor's	Teaching assistant	X	9-12 online tutoring
TA-5	1.5 years	Left	Education	Master’s	Teaching assistant	H	Online language learning
TA-6	2 years	Employed	Accounting	Bachelor's	Teaching assistant	N	9-12 tutoring, language learning
SA-1	3 months	Left	English	Bachelor's	Sales manager	H	K-12 online tutoring
SA-2	1.5 years	Employed	Economics	Bachelor's	Marketing manager	G	Online K-12, continuing Edu
RD-1	1 year	Employed	Computer Science	Bachelor's	Software engineer	T	K-12 LMS
SI-1	4 months	Left	Economics	Master’s	Strategy Analyst	H	Online arts education
SI-2	1 year	Left	Engineering	Bachelor's	Investment Analyst	H	Online education, programming

3.4 Data collection

Interviews are recorded with the consent of all participants. The interviews are conducted in Chinese as all interviewees work in China. A total of 12 hours of recordings are obtained for this study. There is one issue in the data collection process that deserves attention in this study. Although this study doesn't include any sensitive issues such as race, gender, political views, ethnicity, it may include information that some companies consider commercially sensitive, such as the specific business and technology development in the participant's company. Although participants are committed prior to the interviews that all information is confidential and anonymised and won't be used for any commercial use, there may still be bias in the responses. To solve this problem, this study also includes a number of participants who had worked with EdTech but have now left the company. Former employees usually have more freedom to express their opinions as they are not restricted by the company's information security and privacy regulations. And, fortunately, no participants in the study decline interview requests and are all happy to share their experiences, practices and insights in the EdTech industry. We can therefore conclude that the data collected for the study is real and unbiased.

3.5 Data analysis

After interviews, all recordings are transcribed. The audio recordings and transcripts are the data collected for this study and the data analysis is mainly based on the transcripts. The process of analysing, coding, and generating themes for the transcript is carried out in Chinese, and the text is not translated into English until the final theme generation stage. I involve in the transcription and translation process to ensure that the meaning of the participants is conveyed correctly.

The data collected from the semi-structured interviews are analysed to elicit findings and discussion. Braun & Clarke's (2006, p.87) six phases of thematic analysis are applied in this study. The six phases are "familiarizing yourself with your data, generating initial code, searching for themes, reviewing themes, defining and naming themes, and producing the report".

In this study, the inductive approach is used for thematic analysis. The inductive approach allows the data to identify themes (Braun & Clarke, 2006). The theory in this study, which is SCOT, mainly drives the starting point and underlying rationale for this study. The findings

and contributions of this study go well beyond the theory itself and therefore it is appropriate to use an inductive approach to uncover themes.

Specifically, I first familiarise myself with the data primarily through the process of transcribing the recordings. I listen to the audio recordings of the interviews repeatedly to get an initial understanding of the data. After each recording is transcribed, a summary sheet is created to record the basic information and key insights from each interview. Second, I code the data. I highlight parts of the text (usually phrases or sentences) and tag codes to describe the content of the text. In this stage, the aim is to code thoroughly - I highlight all relevant or potentially interesting content where possible. The data is eventually collated into groups identified by codes that provides a brief overview of topics that recurs throughout the data. In step three, I look at the codes and search for possible themes. Often, multiple related codes are combined into a single theme. In this process, some vague or irrelevant codes are removed, and a brief thematic map is generated. Step four is mainly to ensure that the themes are appropriate and supported by accurate data. At this stage I return to the data and compare the themes with the original data, making them more reliable by splitting, combining, discarding, or creating new themes. Finally, I define and name the theme and finalise the writing. The final thematic map and some corresponding transcript extract samples are presented in the table in Appendix 5.

3.6 Ethics

Ethical issues need to be considered in social science research that requires data collection (Newman, 1994). This study follows ethical guidelines for educational research issued by BERA (Association, 2011) and University of Oxford Central University Research Ethics Committee (CUREC) best practice guideline in terms of consent, transparency, right to withdraw, privacy and data storage, disclosure and other standards to protect the rights of participants. This study has received ethical approval from CUREC. I explain the purpose of the study, withdrawal rights, data collection and data processing to all participants prior to their participation in the study.

In order to protect participants' privacy, they are instructed to use a pre-assigned unique number instead of their name and company name before interview. In general, the audio recordings don't contain identifiable information. When the recordings are transcribed, I review the content again to ensure that the transcript does not contain identifiable information directly. These data is fully anonymised and not associated with the research output.

Information like job content and business details that have to appear in the research output to provide contexts has been trimmed to erase participant's personal information.

Regarding the online interviews, although the online interviews allow interviewee to pick their own comfortable location and setting, they also raise some concerns about privacy and confidentiality issues (Clark et al., 2021). Prior to the interview, interviewees are advised to choose a private room for the interview and are allowed to freely choose whether or not to turn on the camera. When consent is obtained, the researcher used an external dictaphone device to record the audio and avoid being uploaded to an uncensored cloud server. The conferencing software used in this study (Tencent Meeting) uses SSL and AES-256 encryptions to ensure information security.

Chapter 4 Findings

In this section, the findings are presented. The relevant themes generated from this study are grouped into three categories, namely practitioners' understanding and beliefs about EdTech, economic shaping of EdTech, and political shaping of EdTech, to answer each of the three research questions. In section 4.1, I summarised three themes of practitioners' understandings and beliefs about EdTech, relevant to the relationship between technology and education, evaluation of the status quo and vision of EdTech, and internal values heterogeneity. In section 4.2, I summarise five themes of the economic shaping of technology, mainly covering the topics of profit-seeking nature of EdTech companies, the mechanisms involved in achieving profits, and the conflict between business and education in the private sector. In section 4.3, I summarise two themes of the political shaping of technology, mainly related to the huge restructuring of the EdTech industry after the double reduction policy and the concerns from practitioners.

To help better understand the findings, it is necessary to first briefly describe the roles and main job responsibilities of the five types of EdTech practitioners involved in this study. First, product & operations managers (OP) are usually the core of a product-centred team and are primarily responsible for the planning, design, and management of EdTech. Second, teacher & teaching assistants (TA) include the roles of teachers, teaching assistants, and teaching research, and are responsible for teaching live or recorded online education classes, assisting teachers in and after classes, and developing course content, respectively. Third, sales & marketing managers (SA) mainly consist of sales managers and marketing managers, who are responsible for the sale of online courses and the promotion of the educational brand with advertising. Fourth, research & development engineers (RD) are responsible for all educational software development, including coding, front and back-end development, algorithm building, and data analysis. Fifth, strategy & investment manager (SI) consist of strategy analysts and investment analysts, who are responsible for growth management strategies for educational business and analysis for external educational investments.

4.1 Understandings and beliefs of EdTech

4.1.1 Technology as a tool in education

As discussed in the literature review, EdTech is understood as a combination of education and technology, often defined as the application of information and communication technology

(ICT) in education (Rodriguez-Segura, 2021). Understandings and beliefs in EdTech therefore inevitably encompass the complex relationship between education and technology and the value technology can bring to education. My interviews show that EdTech practitioners generally see technology as a tool in education.

> I think (technology) just provides value as a tool. My first knowledge of EdTech was the teaching tablet from Company H... The students were using the tablet and the correct percentage came out from the teacher's side after they had done the questions, something we were very jealous of at the time, and we thought it was a very good tool. (TA-1)

> (The company) regards producing educational products as producing tools... all thinking about education in terms of fixed sets and templates. (OP-3)

In addition, EdTech practitioners see technology as a tool that is primarily responsible for providing efficiency in education. For example, OP-1, whose role is to plan an adaptive AI-tutoring software for high school students, when asked about the value of technology in education, questioned me that, “isn’t technology consistently an efficient tool for humans?”. She also told me that, “adaptive (technology) will improve academic scores more efficiently... because only targeted, relevant and incorrect problems will be provided for students”.

In other words, EdTech practitioners often believe that traditional educational methods are inefficient, and that ICT can be used as a tool to improve efficiency in the education system by, for example, replacing repetitive tasks in the teaching and learning process:

> (Our technology) is also known as school-entry business, which helps offline public and private schools to improve their previously low learning efficiency. (OP-2)

> Once you have taken up online education, you can go to class immediately after your lunch, and this repetitive time cost is saved, greatly increasing efficiency. (TA-4)

Most EdTech practitioners share a very deep obsession with efficiency and a belief that technology is the best way to increase efficiency of education. Therefore, they believe that technology can be used as a tool to empower education. This is the dominant narrative we found among practitioners about the relationship between education and technology.

4.1.2 Legendary vision with poor technology

The interviews show a seemingly opposing narrative among practitioners, whereby EdTech practitioners often believe in and are willing to describe a grand vision of EdTech, but at the same time acknowledge that the existing technology is really bad.

First, the interview shows that EdTech companies often describe EdTech as a revolutionary innovation and suggests that it will go a long way and have sufficient social impact in the future. Practitioners often buy into this visionary narrative and become the exporters of such corporate vision:

> We (meaning our colleagues) agreed that relying on Company B's powerful algorithms and technology and the content built with care by the teachers, AI classes can do more than... It would be a great thing if made... It's a change in EdTech, and then in the future I look forward to EdTech that allows for an immersive learning experience, which is a very ambitious dream. (OP-1)

Companies often use terms such as educational artificial intelligence (AI), educational big data, and educational analytics to describe cutting-edge EdTech. Taking AI classes as an example, companies claim that AI classes can personalise teaching by analysing students' reactions. However, most practitioners responsible for the design, development, and operation of AI class software say that these so-called educational AIs are far from "smart":

> It calls itself AI... but I think it's just a simple recorded class with a few designed learning paths, but it's not really going to be particularly different from a recorded class. (OP-3)

> Although it is a product that I am responsible for, I still rather question whether it is truly personalised. (OP-2)

Some practitioners have even pointed out that AI classes only "create" the illusion of greater intelligence:

> Our products create the illusion of being smarter, that is, they make you think that your choice is really your choice. (OP-1)

Practitioners also talked about the potential sources of limitations on existing EdTech, such as the immaturity of the technology, the lack of data collection, and the complexity of the educational process.

While practitioners acknowledge the limitations of existing EdTech and deny narratives that existing EdTech is disruptive, practitioners still demonstrate confidence and patience in the vision of EdTech and its long-term value:

> I think the vision is achievable, it's not a pipe dream because we all know that Company B has a strong algorithm, and we all know that the data must be right... (OP-1)

> I think if time had gone on a little longer and the technology had developed a little better, I think this reading technology would still bring a lot of value. (OP-4)

This is a very interesting finding. Acknowledgement of the poor status quo and trust in the legendary vision seem to be contradictory but are nevertheless true among EdTech practitioners. They express their dissatisfaction with the current technology being over-hyped by the industry, but generally believe in the great role that technology can play in education in the long run.

4.1.3 Differences in the perceptions of practitioners in different divisions

In traditional educational institutions, such as public schools, the teacher is usually at the centre of all teaching activities and responsible for almost every activity related to education and teaching. However, in EdTech companies, there is a more complex and specialised division of labour. As shown at the beginning of chapter 4, different positions in EdTech company take different roles and responsibilities. This division of labour is based on the functional organisational structure, which is common to modern business organisations. According to the organisational structure theory, it provides "specialisation, operational speed, and operational clarity" (Judge & Robbins, 2017, p.354). The interviews argue that this structure is important to offer a better quality of teaching. For example, TA-2, as a teacher for online English courses, said that the visual design in the courseware is created by colleagues who specialise in design, and it's naturally great and attractive to students. Interestingly, OP-1 told me that some of the online recorded tutoring class provider record their classes with professional actors, not teachers. These actors hired from film schools have never been teachers and don't know how to teach - and they don't have to, because a professional teaching and research team designs every lesson and writes scripts for them - they just have to play and focus on making the class as expressive and engaging as possible. Although OP-1 claims that this is not a common practice in the industry, she admits that this division of labour does go some way towards achieving its purpose: allowing the teacher to focus on curriculum development and the actor

to focus on expressiveness. This general division of labour within EdTech companies has contributed to the quality of education.

However, this organisational structure has also produced significant differences in perceptions and beliefs about EdTech between divisions. The interviews show that practitioners in divisions closer to education and teaching often have more "educational sentiments":

> I want each learner to reach his maximum potential and to grow. This is what seems to me to be the essence of education. (TA-2)

> We little teaching assistants were there for sentiments. The English teacher helped me so much in my senior year... we feel it is a great honour to be her teaching assistant. (TA-6)

Similar discourses are mainly drawn from product & operations manager (OP) and teacher & teaching assistants (TA). However, in divisions far away from education and teaching activities, which includes sales & marketing manager (SA), research & development engineer (RD), and strategy & investment manager (SI), practitioners said that they enter the industry randomly with the rise of the EdTech when asked about the motivation for their work in EdTech:

> It was really just a random choice... because this (EdTech) was just so popular, and a lot of people were doing it. (RD-1)

> I picked it at random because the job market at the time was that education companies were hiring the most. （SA-2）

The difference in the motivation for education and EdTech triggers a disparity in the values valued by different divisions. There is a clear divide between those whose role was primarily teaching valuing students' development and potential achievement and those whose role was primarily marketing valuing grades and selling to the parents:

> Education as I understand it is about two goals, selection and nurturing. The reason why so many people attack education now is because we put too much emphasis on selection and too little on nurturing. (TA-1)

> (Marketing) amplifies what parents care about most. What do parents care about most? Grades. (SA-2)

EdTech involves many stakeholders - companies, teachers, parents, students - with different value propositions for education. EdTech practitioners need to first understand the value propositions of different stakeholders, balance business value, educational outcomes, and

student development, and then to decide on the orientation of EdTech. This complexity ultimately results in differences in practitioners' understandings and beliefs about EdTech. This vast difference in perception between divisions sets up the potential for conflict and compromise on technology in collaborations, which will be discussed in detail in the following section.

4.2 Economic shaping of EdTech

4.2.1 Pursuit of profit as the main motivation of EdTech company

First, it is important to note that EdTech companies' primary motivation as a commercial organisation is to maximise their profit:

> In meetings, the leaders repeatedly asked when we would be profitable. (TA-5)

> The company decision was more about how to divide the capital wisely to invest in the business. When we reported our revenue plan for the year, we felt that $10 million was a big number… but the company felt we had no room to grow in the future. (OP-4)

The interviews also sought to understand the key motivations of companies by asking the reasons for entering the EdTech industry. Interestingly, two of the companies covered in this study are technology companies that are not originally in EdTech industry. They are originally the Chinese social network and video platform leaders. They both set up independent EdTech divisions during 2018 and 2019 to focus on providing innovative EdTech. Interviews revealed that these companies mainly covet the vast market size and profitability possibilities in EdTech, also partly for undertaking the corporate social responsibility (CSR) to achieve stable corporate growth:

> I feel like it was about capturing the market... the future of online education was still very good at that time, the profit model was very clear, the market demand was also very big, and Company T was definitely not going to give up this opportunity. (RD-1)

> All companies have to take on CSR, on the one hand to seek for government's support and on the other hand to show the public its positive image... but in the long run it will certainly help the company to continue to make profits and grow. (OP-1)

> Company B does whichever industry invests the most ads on Company B (the video platform). Company B makes back all the money it invests in EdTech from the money other education companies spend on advertising on the platform. (TA-1)

Therefore, while EdTech companies often advertise their legendary vision as "innovating education for everyone" and promise to bring more equal access to education to remote and disadvantaged families, their primary motivation as commercial organisations is to make a profit in EdTech where the market is growing rapidly, and the profit model is clear.

4.2.2 Indicator-oriented incentive program shaping the design of EdTech

In EdTech companies, performance reviews and salary incentive programs are often used to ensure the alignment of employee performance with the overall goal of maximising revenue. Interviews reveal that these incentive programs for EdTech practitioners are primarily related to indicators such as student satisfaction and student subscription renewal rates. For example, OP-1, when asked about the most important goals in the design of AI tutoring software, said that they aim for both subscription renewal and class completion rates. Some online education teachers said that their salary is closely linked to their performance, which means that their students' renewal of their courses is linked to the teacher's salary. Some institution managers keep a monthly or quarterly count of teachers' course renewal rates and generate a public leader board based on this, which is used to motivate teachers to improve their course renewal rates:

> (Online education teacher) performance is linked to salary increases… If you have the highest performance for four consecutive periods, your salary can be doubled at the maximum. (TA-2)

Due to the large proportion of salary incentives, practitioners are led to pursue student satisfaction and consistent subscriptions to classes to achieve higher ratings on indicators, leading to corresponding salary incentives. As a result, these indicator-driven incentive program influence all decision practitioners make in the design, production, and delivery of EdTech. For example, tutoring software has to be designed to be lively and funny for students' engagement; online education teachers have to express intellectual anxiety in their courses to steer students towards ongoing subscriptions to courses. It profoundly influences the design of EdTech:

> We were thinking about user pleasure when we were planning the product, for example, how often there should be a small climax to attract students' attention and allow them to form the idea that this product is good to use. (OP-1)

> Our goal is renewal rates... so how do you stimulate renewal rates? A student must renew because he hasn't learnt enough... then you split one point of knowledge into ten lessons to sell. (OP-1)

It is important to note that the interviews also reveal the percentage of performance incentives varies from position to position. Sales-related positions will have a higher performance-linked component of salary than teachers. In addition, different people have different attitudes towards incentive program. Some teachers in the interviews indicated that they do not care about the performance reviews, but also noted that there are many practitioners who value the incentive program a lot. In general, the indicator-oriented incentive program widely used in EdTech companies guide every decision practitioners make about EdTech design, therefore shaping the design of EdTech.

4.2.3 Profit-driven design contributing to the quality of education

How does the profit-driven design influence EdTech? Interviewees show that the profit-driven incentive program has objectively contributed to the quality of education, and they see an inherent unity in renewal rates, satisfaction, and learning outcomes:

> The student needs continuity in learning, he can only improve his marks if he studies continuously. The essence still depends on the results. (TA-1)

While quality of education is understood differently by different practitioners, interviews believe that the focus on satisfaction and renewal rates has made EdTech practitioners more student-centred, therefore enhancing the learning experience and outcomes:

> The earliest time was in 2009, when teachers didn't care about the results of their students' lessons... teachers won't see students after the lesson. When they started doing renewals (meaning they concern about the subscription renewal rate), teachers started to gradually understand the whole educational thing. (TA-1)

In particular, the interviews refer to the comparison between teaching at EdTech company and public schools. It shows that quality of teaching in public school and teachers are not linked:

> Those of us who are teachers in the company make our living by teaching, you get paid for teaching well, you don't get paid for teaching badly. Public school teachers have iron rice bowls (meaning stable income in Chinese) and they have no incentive to constantly improve their teaching quality. (TA-3)

In contrast, because of the pursuit of profitability behind, the education provided by EdTech companies has more motivation to pursue a better teaching experience and quality of learning. It is also interesting to note that although EdTech practitioners say that those working within the company are more like "professional teachers", the level of respect they receive from students and parents is quite different compared to public school teachers. Public school teachers tend to be more respected by students and parents:

> I originally thought that education was about being a teacher, a respected profession, but then I found out that education is a service industry, people are paying for your services, your knowledge is being turned into a service and parents are not respecting you emotionally. (TA-5)

This is a very interesting point about the comparison with public schools. In general, practitioners recognise the set of incentive programs that prevail within EdTech companies and acknowledge the objective contribution of profit-driven design to the quality of education in the private sector.

4.2.4 Profit-driven design compromising educational outcome for business interest

The interviews also show that the profit-driven design of EdTech triggers a great deal of conflict between business interests and educational outcomes, leading to lots of compromises with EdTech:

> It (EdTech) could have served the learners better, but because it had to succumb to the pressure to make a profit, it have to make some compromises, which are at every turn all the time. (OP-1)

In this section, we focus on two specific cases of EdTech compromise from the interviews to help us understand this dilemma, they are online education free trail class and a reading product designing procedure.

Free trial class is a strategy that is frequently mentioned in interviews by online education teachers, sales and other practitioners. It is the most common learner acquisition mechanism used in the online tutoring business. Usually, institutions attract students by offering free or very low-cost courses, with the trial class containing both normal teaching content and sales content that leads students to continue their study with the regular-priced course. For example, Company H's primary school tutoring trial session for summer was designed as follows：

> The ¥20 trial class includes 10 lessons, 4 in Chinese, 4 in Math and 2 in English. Three of these lessons are live and the others are recorded. Students also get a set of tutorial book, notebook, pen, and a timer as the gift. What parents are told is that they buy the set of gifts for ¥20 with a set of free trail lessons. (SA-1)

The design of the trial class set is very strategic. If the course is completely free, students are likely to have no incentive to attend the class, but students are more likely to attend when they have already paid ¥20. In this gamble between company and student, the company has gone to great lengths to design the free trial set from a business perspective to improve the return-on-investment ratio.

However, the quality of online tutoring trial sessions is relatively bad, mainly because they are not only attended by students, but also by many parents who would like choose courses for their children. There is no way for the online teacher to deliver real knowledge in these sessions. For example, TA-1, an online tutoring teacher, said that the content of trial classes has to be easy, but the tone has to be strong, and as a result, the trail session ends up a lie.

Almost all teachers in online tutoring institutions are required to teach free trail classes, and in some EdTech companies, teacher's performance in free classes is the main indicator for performance review. Teachers in the interviews said that these free classes are a great distraction from teaching. Most of them expressed the dilemma of balancing economic interests and their educational philosophy:

> I just feel like it makes me feel bad when I say something big, but there's nothing I can do about it, so I say it. (TA-1)

> For the teacher, he needs to strike a balance between his educational philosophy and his financial interests, or his key performance indicator (KPI). (SA-2)

Another example is a compromise in the design of a picture book reading software. The product manager responsible for the design of the software, which uses image recognition to guide learners through picture books, describes it as:

> Usually, the reading process consists of a pre-reading, reading and post-reading session. For example, after the learners finish reading the book, we design some small exercises and games to help the children think... but this leads to a long product experience chain, and in order to increase the completion rate of reading, we end up having to cut out the pre-reading and post-reading parts. This way, children read when they come and leave when they're done,

> and the completion rate did go up. But we had ideally wanted the software to be 100%, we ended up with only 20%. (OP-4)

Similar compromises happen every day in the EdTech companies. Interviews shows that the main reason for the compromise is the active investment activities in the EdTech industry supporting profitable EdTech projects. For example, one EdTech investment analyst (SI-2) describes the criteria used by investors to screen EdTech projects to me: "the first is revenue synergy and the second is cost synergy". Revenue minus cost equals profit, that is all that investors care about with EdTech projects.

These commercially reasonable designs and arrangements often diverge and contradict educational outcomes, which causing compromise in EdTech. Therefore, many interviewees pointed out that:

> I still feel that the EdTech industry is a rather fickle place. (TA-2)

> The EdTech industry is not really doing education. (TA-5)

4.2.5 Profit-driven design leading to chaotic situations in the industry

The interview additionally mentions the industry chaos caused by the profit-seeking behaviour of EdTech companies, which mainly includes excessive advertisement placement, false advertising and micro-loan traps. At the peak of the EdTech industry in China between 2020 to 2021, online education providers' ads covered almost all of the most expensive advertising space both online and offline. According to an investment analyst in the interview, the money raised by several head companies at that time was rarely spent on curriculum building and software development, and almost all of it was invested in advertising. Take GSX Techedu as the example for over-advertising, a Chinese technology education company listed on the NASDAQ, whose annual report for 2020 shows that its net revenue for the year was 7.12-billion-yuan, while its selling expense was 5.82-billion-yuan, accounting for 81.63% of the net revenue. The annual report states that its selling expenses are mainly used for free trial courses for new users, advertising and marketing, which means that for every 100 yuan paid by students and parents for tuition, 81.63 yuan is spent on advertising expenses by the EdTech company (GaoTu, 2020). An EdTech marketing manager explained EdTech's customer acquisition mechanism, noting that EdTech companies have to advertise heavily in order to achieve its growth goals:

> The logic of learner acquisition at EdTech is all the same across companies. It's that you have to invest money in the marketing activities to attract students with low-priced classes. Then they will be moved to sales managers, who get them to buy high-priced classes, which is thousands or tens of thousands of dollars. (SA-2)

The interviews also show that profit-driven design has led to a trend of false advertising within the industry in order to achieve growth targets. EdTech companies commonly exaggerate the effectiveness of their teaching in their recruitment advertisements to attract more students and parents to enrol:

> Telling you that you don't have to do the problem sets and don't have to study, and that you can get the answers in 5 seconds by listening to my class. It's actually selling the class. (TA-3)

The interviews also identify instances in the adult online education sector where students are induced to borrow small consumer loans to pay high tuition fees in advance to meet sales targets:

> K-12 education is restrained, but if you go to adult education, it will have a lot of instalment loans (microcredit) for students to pay their tuition fees in advance. (SA-2)

When asked about when the industry started to get chaotic, practitioners said that the shift in the industry is largely due to the influx of capital, with investment and financing in the education sector increasing after 2019. Within those years, a large number of capital-backed EdTech companies were established, and they were forced by pressure from shareholders to make a profit to adopt some special forms of sales and advertising:

> Like Company M, they bring in capital right from the start and have to expand like crazy, lacking the upfront build-up, they use all sorts of weird and wonderful ways to get customers. (SA-1)

With the help of capital, the EdTech industry has seen unprecedented growth and an influx of talent into the industry, but it is inevitable that profit-driven design has led to a lot of chaos in the industry that is against the benefits of learners.

4.3 Political shaping of EdTech

4.3.1 General positive on the direction of policy

It is saddening to talk about the impact of the double reduction policy on the EdTech industry: almost all companies in the EdTech industry have undergone huge business restructuring and

multiple rounds of layoffs since the double reduction policy took effect in July 2021. One of the EdTech companies involved in this study, for example, had reached a maximum of over 10,000 employees in its EdTech division and was left with less than 2,000 after multiple rounds of layoffs after the policy. During the interviews of this study, the company underwent further rounds of layoffs, and all of the practitioners in this study from that company were laid off within a month after the interviews. As these were industry-level layoffs, most employees had difficulties in continuing to work in the private education sector. However, the public education sector has a high barrier for entry, so most people have to choose another career after being laid off. This is a huge shock to practitioners.

The EdTech industry has received such a large impact mainly because of the large share of K-12 online subject tutoring in this sector. Although there are many segments in the EdTech industry, K-12 online tutoring in China is one of the few businesses that has proven to have a large market demand, a large market size and a clear profit model. As a result, K-12 online tutoring has been the most active segment of the private EdTech sector in China, which is also the main target of the current double reduction policy adjustments.

However, despite the significant impact of the double reduction policy on practitioners' careers, practitioners remain generally positive about the direction the policy is taking for the healthy development of EdTech:

> Overall, it's a good thing. Why? Because it has put a baton on the schools (to show the direction). (TA-2)

Practitioners point out that the policy helps to weed out particularly problematic profit-seeking behaviours, people and companies in the industry, therefore helping EdTech to focus more on the "essence of education":

> That so-called people who want to make a quick buck and then don't really want to do education, that part of the industry will definitely be cut out. It is definitely good for the overall environment. (OP-1)

> ...Dropping a lot of unhealthy and vicious competition and truly return to the essence of education. (SA-1)

Although practitioners do not usually explain what the essence of education is, the phrase "back to the essence of education" is frequently mentioned in reference to the way EdTech has been shaped by the double reduction policy.

In addition to the layoffs, the double reduction policy has also brought about a dramatic change in the development of EdTech. Following the banning of K-12 tutoring, EdTech companies began to focus on other segments such as digital education infrastructure, digital campus construction, learning management systems, online arts education, and online continuing education:

> People say they can't make money from to C (customer) market anymore, so they are turning to B (business) market. For example, Company K as I know is doing smart campuses. (OP-1)

Compared to the previous frenzy in the private EdTech sector, the current EdTech sector appears restrained and cautious:

> The national policy clearly wants you (the company) to put the money you raise on polishing your technology and products. (SI-2)

Overall, the double reduction policy has had a significant impact on the specific direction of EdTech, with the previously popular but much maligned K-12 tutoring business disappearing and the emerging focus on the long-term development of EdTech. Despite the huge impact of the policy on practitioners' careers, the vast majority of practitioners recognise the role the policy has played in guiding the healthy development of the industry.

4.3.2 Failure to address the structural issues with unclear future of EdTech

While practitioners are satisfied with the policy's directional guidance to EdTech, practitioners said that it failed to propose specific alternative solutions to the systemic problems that exist in the education system. The interviews show that practitioners believe that a major reason for the double reduction policy is that the private education sector amplifies educational anxiety at the social level. This educational anxiety mainly refers to the widespread belief among parents that "the only way to get into a good university and get a good job is to get a higher score in the Gao Kao (college entrance examination)". Practitioners believe that the EdTech industry has amplified the educational anxiety due to the involvement of capital and the over advertising. However, the anxiety stems from the scarcity of quality education opportunities. The capability development of public schools is still far from keeping up with social needs, and educational anxiety still grips students and parents. The double reduction policy therefore "hides" the anxiety, rather than "solves" it:

> I don't think the anxiety of Chinese parents can be solved by the policy, unless the Gao Kao exams don't count for marks from today onwards. (OP-1)

Another proof that the double reduction policy only "hides" parents' educational anxiety is the emergence of a black market in online education after the implementation of the policy. Despite the policy ban on K-12 tutoring, the demand from parents and students for tutoring classes remains, so many teachers are starting to take online classes "secretly". However, the price of these black-market classes has generally increased significantly compared to the previous price, mainly because teachers are taking the risk of breaking the regulation:

> Making the inequity even worse, those who are better off still have the means to access a better-quality after-school education. (SA-2)

TA-2, when asked about the black-market online courses, said that it is difficult to find the right teacher in the black-market, therefore it is even more dark. Other practitioners also criticise the after-policy EdTech market a lot:

> But really it's just a change of face, you have Chinese class that becomes the literary class, Math is a thinking-training class, and English is whatever. (SA-1)

> It's definitely not a cure, and there really is a policy at the top but a response at the bottom. (OP-1)

Practitioners expressed their frustration with the solutions proposed by the policy during the interviews. When asked how EdTech will develop in China in the long term after the policy, practitioners said the future is unclear and unpredictable, and that the Chinese EdTech industry is still in a period of adjustment from the post-policy crackdown. Only when a stable and predictable policy environment emerges will practitioners, capital and talent dare to continue investing in the industry. Most of the practitioners have little confidence in the short-term development of EdTech and are looking for career transformation.

Chapter 5 Discussion

5.1 Understandings and beliefs of EdTech

In this study, we applied the theoretical framework of social construction of technology (SCOT) to study the social construction of EdTech in private sector in China and answer the three research questions. The first research question in this study is "what are the understandings and beliefs of Chinese EdTech practitioners in EdTech?", which is a relatively open and exploratory research question. This section provides an exploratory look at EdTech practitioners as a group, identifying two themes of generality and one theme of heterogeneity that set the stage for answering the two following research questions.

First, the study found that in the EdTech industry, practitioners agree with the narrative of technology as a tool to empower education. This narrative has long existed in the industry and is underpinned by the understanding of technology neutrality. Technology neutrality is the belief that the inventor of a scientific technology or tool has no control over how the user uses it (Maxwell & Bourreau, 2014). Although technology neutrality has been shown to have many flaws, and is often self-defeating (Greenberg, 2015), we find that when it comes to the value of technology, the dominant discourse among practitioners still recognises the value of technology as a tool. In fact, early regulators and administrators also believe in the information and communication technology (ICT) neutrality until recent years when they began to impose strict regulations on large platforms (Chander & Krishnamurthy, 2018). Facebook's CEO, Zuckerberg has been controversial for his support of feed algorithm being neutral (Madrigal, 2017). Even in his latest vision of a decentralised metaverse, the presupposition of technological neutrality still exists. In the analysis of the interviews, we can see that most of the functional sector practitioners entered the industry at random, and they entered EdTech more because it is a technology industry. Those who have a passion for education and want to achieve something in education are confined to teaching positions. Therefore, we can conclude that EdTech is, at least statistically, more a technology industry rather than an education industry. It is therefore not surprising to get such a theme in EdTech.

Second, the study echoes the results of the private sector viewing EdTech as a legend. Eynon and Young (2021, p.174) interviewed three separate EdTech sectors - academia, business sector and public sector - and revealed that the business sector tends to refer to AI in lifelong learning as a legend, meaning "a popular (and old) story, echoing the AI hype cycles of the past few

decades that AI could be utilized to support some of their product goals". This is in line with the grand vision of EdTech described by the practitioners in this study. But beyond the legendary vision, this study also finds that practitioners are not actually satisfied with EdTech as it exists, believing it to be a long way from being truly intelligent, such as the AI-supported educational software we discussed in section 4.1.2. The trust in the grand vision and dissatisfaction with the present echoes the previous EdTech research which found that the private sector "promise much but deliver little" (Selwyn, 2016). The research proves that this contradiction is not only recognised by the academia, but also in the understandings and beliefs of practitioners. That is, what has been achieved so far with EdTech is only a very small and basic part of the picture, and there is still a big gap between what is promised and what is practically possible.

Third, the findings on the heterogeneity of understanding and beliefs about EdTech within the private sector is one of the main contributions of this paper. In previous literature, the private EdTech sector has often been treated as a whole. For example, Eynon and Young's (2021) study on SCOT of AI in lifelong learning finds that commercial players rarely focus on the pedagogical aspects of AI in lifelong learning. And this study reveals the heterogeneity of different divisions in the private sector through a more in-depth study of different positions in the EdTech company. It shows that in private EdTech organisations the ignorance of education does exist in functional divisions. For example, educational investment and strategy analysts tend to focus only on the costs and revenues of EdTech. However, there are also a large number of practitioners in EdTech companies who have a passion and aspiration for teaching and learning, mostly in positions closer to teaching such as teaching researchers, teaching assistants, and product managers. This helps us to understand the private EdTech sector thoroughly, and also paves the way for understanding the conflict between commercial interests and educational outcomes identified in the research questions that followed. The existence of this heterogeneity may provide a solution for the future development of EdTech in the private sector, i.e., simply by changing the power relations between the different positions in the organisations can help private EdTech to focus more on pedagogical aspects.

5.2 Economic shaping of EdTech

The second research question we discussed in this study is "how do economic considerations influence the construction of EdTech in the private sector". First, this study echoes past findings of private EdTech's focus on profitability. Picciano and Spring (2012) argue that

education has become the domain of private organisations and corporate entities who see it as a market for technology and profit. Eynon and Young (2021) discovers that in the private sector, only profitable AI systems will be developed. This study found similar findings through interviews with practitioners and confirmed profitability as a key driver and goal for EdTech company.

The precise ways in which EdTech companies pursue profits has rarely been explored in literatures. In this study, the specific mechanisms by which private EdTech companies ensure profits is discovered, which is one of the main contributions of this section. The companies ensure the achievement of their goals through the design of employee performance review and incentive programs linked with satisfaction and renewals rates. So, for a teacher this would mean doubling the salary if achieving the highest student satisfaction for several quarters and for a sales manager this would mean ¥1,000 bonus every additional ¥10,000 of online courses sold. The well-designed mechanisms have been proven to permeate every corner of private EdTech organisations, influencing the understandings and beliefs of practitioners and therefore shaping the design, production, and delivery process of EdTech. It fully supports the theory of the shaping of technology by economic factors, and as a concrete case complements the mechanisms inherent in the process of the construction of technology.

On the topic of the conflict between business and education, this study provides many concrete examples to help us better understand how such conflicts occur within private EdTech companies, how practitioners understand and deal with balancing these conflicts, how EdTech is shaped in the game of interests, and why educational outcomes are often the compromised party. The conflict between business and education found in this paper has been expressed in similar terms in much of the past literature (e.g., Aviram & Dotan, 2009; Brancaleone & O'Brien, 2011; Selwyn, 2016). This study provides more cutting-edge examples to support this conflict and provides mechanisms for balancing and compromising against it within companies from a practitioner's perspective.

There is one more interesting finding in terms of the conflict that has rarely been mentioned in the past literature. The study shows that to a certain extent the profit-driven design of EdTech and educational outcomes are aligned, and market-based mechanisms can contribute to the improvement of quality of education. This is largely due to the inherent alignment between student learning outcomes and student satisfaction rate that the company values, and under the market mechanism, EdTech companies have to continuously improve the quality of teaching

to survive in the market. Although there is little literature or theory explaining this, we have found similar phenomena in the past literature for other values in conflict with commercial interests. Take the alignment of corporate social responsibility (CSR) and profit as the example, although in the short term, CSR does not contribute to financial performance of the company, but in the long term it contributes to corporate image, therefore improving the financial performance (Cornell & Damodaran, 2020). A similar relationship may exist between the conflict between business and education.

This study also exposes the latest disruptions in the industry caused by profit-driven design. It includes over-advertising, false advertising, and small loan traps. The possible reason for the industrial chaos is the lack of proper regulation. As the EdTech industry has grown too rapidly, EdTech was introduced to the market before the relevant rules and laws were in place, therefore giving rise to a lot of chaos. Considering the two-sided nature of the impact that capital and market mechanisms bring to EdTech as found in this study, we should not just blame capital and business for these industrial disruptions, instead we should find a solution that tends to avoid harm. Market-based mechanisms and competition under proper regulations can help to improve efficiency, motivate practitioners to innovate and promote educational outcomes at the same time. Therefore, how to use economic factors and market-based mechanisms and how to develop a set of regulatory systems to promote the development of EdTech are policy implications worth considering.

Overall, this section contributes concrete examples to the SCOT of EdTech and political economy of EdTech by identifying the specific mechanisms through which economic factors influence the shaping of EdTech through an in-depth study of the private sector, helping us to better understand EdTech in China.

5.3 Political shaping of EdTech

The third research question is “how does the double reduction policy impact practitioners’ beliefs and the future construction of EdTech in China”. This study can be seen as the first to examine the impact of the double reduction policy on EdTech in Chinese private sector. In this section, the study first identifies the short-term impact of the double reduction policy on EdTech, mainly referring to a significant change in the direction of technology development and the loss of talent and resources from the EdTech sector. The results of the study show that the impact of policy on the construction of EdTech in China is significant. Knox (2020) takes the educational AI as the example and argues that the political and economic context in China

is different from elsewhere and central government policy has established an important place for the educational application in the national strategy. My study, taking the double reduction policy that has had a major impact on the EdTech sector as the example, provides another case study in understanding the mechanisms by which policy shapes EdTech.

This study also provides a practitioner's perspective on the double reduction policy: while the policy is showing a right and healthy direction, its effectiveness is yet to be verified. Practitioners mainly believe that educational anxiety is endogenous and long-standing in the Chinese education system, which is a structural problem embedding in the system, not a problem that can be solved by a simple policy. This is in line with Xiang's (2019) argument that China has been introducing policies to reduce students' burdens for decades, but the actual results have been mediocre. Due to the rapid implementation of the policy and the fact that practitioners do not have a stable expectation of the industry and the policy environment, the conclusions we can obtain so far on the shaping of EdTech by the double reduction policy are still at a relatively short-term level, and its long-term shaping and impact on EdTech is still unclear, which needs to be followed up in subsequent studies.

Chapter 6 Conclusion

We are at a critical time in building EdTech. After the end of the epidemic era that forced all students to use ICT at home to complete their studies, all EdTech players must calm down after the industry fever and think carefully about the future of EdTech. Education, a field that used to be a public service, is today increasingly centred on the private sector. When markets, economies, businesses, and capitals are swarming into the sector, many innovations are taking place that have never happened before. Some of them bring fresh impetus, others bring unprecedented challenges and risks. Therefore, understanding the construction of EdTech is increasingly important.

This study uses interviews with 15 Chinese EdTech industry practitioners, based on the theoretical framework of social construction of technology (SCOT) and political economy of EdTech, and uses qualitative research methods to explore the construction of EdTech in China. While it is a relatively small scale, and non-generalisable study, this study has provided rich insights that could be developed further in future work. This study first explores the understandings and beliefs of practitioners on EdTech and reveals that technology are usually viewed as a tool in education by practitioners. The study also finds a contrast between legendary vision and poor current technology in the private EdTech sector. More importantly, this study uncovers the heterogeneity of practitioners in different positions within EdTech companies, revealing how different positions perceive EdTech differently, and the reasons behind it. This provides us with a solid foundation to better understand the characteristics and culture of the private EdTech sector in China.

Second, this study explores the economic shaping of EdTech in China. It shows that in EdTech, profit remains the primary goal of business organisations, which has crafted detailed indicator-driven employee performance review and incentive programs in order to achieve profitability. The set of incentive programs permeates throughout the company and influences every small decision in EdTech's production process. It helps us to understand the underlying mechanisms by which economic factors shaping the construction of technology. At the same time, this study reveals that profit-driven design in EdTech, while contributing to a certain extent to the quality of education, has also brought about a situation where educational outcomes have given way to financial benefits, and has triggered large-scale disruption in China.

Finally, this study explores the political shaping of EdTech in China using the example of the double reduction policy in July 2021. The findings support the huge impact of political factors on the shaping of EdTech. The double reduction policy has caused a dramatic restructuring of the EdTech industry in China and huge loss of talents and resources of EdTech. Interestingly, the study shows that although Chinese EdTech practitioners recognise the double reduction policy as a positive move for future EdTech, they generally do not fully agree with it in terms of the implementation. Practitioners mainly felt that the policy did not offer viable solutions and failed to address the structural problems in the education system. In addition to the huge impact of the policy itself on the construction of EdTech, the uncertain policy environment also makes the future of EdTech in China unclear and uncertain.

In terms of the implications of the study, first, the study presents the basic structure and internal heterogeneity of private EdTech organisations, which hints at the possibility of regulating power relations through internal governance within the organization to balance profit-driven goals. It means that EdTech companies can be guided to focus more on pedagogical aspects by adjusting the positional discourse in the private sector. Second, economic factors and market incentives have been shown to favour educational outcomes in certain circumstances, so how to control them to avoid harm is a direction that could be investigated in the future. The industry-level regulations and laws may be a possible solution. Finally, a stable and predictable policy environment is a prerequisite for promoting the development of the industry. As we discussed in section 1.1, China has enacted a number of policies to support the digitisation of education, demonstrating China's commitment to the development of EdTech. This study provides a wealth of information, experience, and insight into how EdTech is being shaped by social, economic, and political factors. It provides a basis for how EdTech can be used in the private sector in the future to avoid harm and balance the interests of all parties to better benefit learners.

According to current research, EdTech is still very early in its development globally, with many technologies, products and services at the concept and blueprint stage. There are still thousands of companies and practitioners working in all corners of the globe to develop the future of EdTech. EdTech needs to adapt to multiple futures, and we need to understand more about the technological frameworks and power dynamics involved as well as the interactions and contexts among the broader social groups behind EdTech to facilitate the healthy development of EdTech in the future. This dissertation has contributed to this goal.

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Appendix 1: CUREC Approval

RE: New CUREC application: CIA-22HT-057

Liam Gearon <liam.gearon@education.ox.ac.uk>
Wed 2022-03-30 17:25
To: Tianyu Zhou <tianyu.zhou@education.ox.ac.uk>
Cc: Rebecca Eynon <rebecca.eynon@oii.ox.ac.uk>;MSc Educational Assessment <msc.edassess@education.ox.ac.uk>

Dear Tianyu

Thank you for the minor amendment.

How is EdTech made? An investigation of practitioners on the constructions of EdTech in Chinese EdTech companies
[CIA-22HT-057]

The above application has been considered on behalf of the Departmental Research Ethics Committee (DREC) in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

Our prior discussion on this was very useful – an impressive team as ever, and project, vastly experienced, and a model of genuine care in relation to research ethics.

I am pleased to inform you, then, that, on the basis of the information provided to DREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly, approval has been granted.

Please continue to follow all current guidance issued by CUREC during the pandemic, notably COVID-19: CUREC guidance on research involving human participants, https://researchsupport.admin.ox.ac.uk/governance/ethics/coronavirus

If relevant please also check the CUREC website for their best practice research guides, these can be very useful in refining the writing up of ethical considerations in your research – see https://researchsupport.admin.ox.ac.uk/governance/ethics/resources/bpg

Good luck with your research study,

Keep well and safe,

Yours sincerely,

All good wishes,

Liam

Chair, DREC

Liam Francis Gearon, PhD, FHEA, FRSA, Docent

Appendix 2: Participant Information Sheet

DEPARTMENT OF EDUCATION

Professor Rebecca Eynon
Email: rebecca.eynon@oii.ox.ac.uk
Tianyu Zhou [MSc student]
Email: tianyu.zhou@education.ox.ac.uk

How is EdTech made? An investigation of practitioners on the constructions of EdTech in Chinese EdTech companies

PARTICIPANT INFORMATION SHEET

Central University Research Ethics Committee Approval Reference: CIA-22HT-057

1. **Introductory paragraph**

You are being invited to take part in a research project on the constructions of EdTech in Chinese EdTech companies. The research is conducted by Tianyu Zhou, a student in MSc Education (Digital and Social Change) program at Department of Education, University of Oxford. And it is supervised by Rebecca Eynon, a professor at Department of Education, University of Oxford.

Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

2. **Why is this research being conducted?**

This research focuses on practitioners within EdTech companies in China through interviews to illuminate the diverse understandings, perceptions, and practices around EdTech in China. It will investigate the construction of EdTech from a micro perspective, providing a means with which to examine and critically assess the likely social and educational implications of EdTech by understanding the perceptions, beliefs, and power relations in commercial organisations of the practitioners who actually have power in shaping the technology. In addition, this study will look at the extent to which China's current policies to reduce the educational burden on students (called "the double reduction policy") have impacted changes in practitioners' beliefs and future EdTech construction.

3. **Why have I been invited to take part?**

The participants in this study are employees currently working in the education technology industry in China or within 6 months of leaving the industry, including teachers, product managers, engineers, data analysts, operations managers, and all other positions in EdTech companies. They should all be at least 18 years old and above. Approximately 20 participants will be recruited for this study.

4. **Do I have to take part?**

No. It is up to you to decide whether or not to take part. You can withdraw yourself from the study, without giving a reason, by advising me of this decision. The deadline by which you can withdraw any information you have contributed to the research is August 12, 2022. If you decide to withdraw, all the information, data, and contribution you have provided with be erased.

5. **What will happen to me if I take part in the research?**

In this study, you will participate in an interview session.

The interviews will be conducted entirely online. After understanding the purpose of the study and agreeing to participate in the study, you will receive this participant information sheet and the informed consent form. After reading the study summary and agreeing to participate in the study, you will need to sign your name on the informed consent form and send it to Tianyu Zhou (tianyu.zhou@education.ox.ac.uk). The interview will then take place at an agreed time via Tencent Meeting. The interview will normally last approximately 40 minutes. The topics of the interview will mainly cover your understanding and beliefs about education technology, the economic interests shaping education technology and the impact of the double reduction policy. With your consent, I would like to audio record the interview so I can have an accurate record of our conversation. Participants can ask to pause or stop the research activities at any time. The interview recordings will be stored in a secure manner for 3 years, after which they will be completely erased.

6. **What are the possible benefits, disadvantages, and risks in taking part?**

There are no known benefits or risks for you in this study. The finding of this study will potentially provide implications for the development of emerging education technology-related policies and the education and technology corporate governance.

7. **What information will be collected and why is the collection of this information relevant for achieving the research objectives?**

Data in this research will be stored in the researcher's encrypted laptop and university authorized OneDrive for Business as backup. They will be stored for 3 years after publication or public release of the work of the research.

The data collected in this study includes interview audio records, manually converted transcripts based on the audio records, your contacts, and consent forms. The researcher and supervisor will have access to the research data. The finding of the research will be drawn primarily from the qualitative analysis of transcript.

8. **Will the research be published? Could I be identified from any publications or other research outputs?**

The findings from the research will be written up in the dissertation for the MSc program. All data and information will be de-identified before storage. I would like your permission to use direct quotations but without identifying you in the research outputs.

A copy of my dissertation will be deposited both in print and online in the Oxford University Research Archive where it will be publicly available to facilitate its use in future research.

9. **Data Protection**

The University of Oxford is the data controller with respect to your personal data, and as such will determine how your personal data is used in the study. The University will process your personal data for the purpose of the research outlined above. Research is a task that is performed in the public interest. Further information about your rights with respect to your personal data is available at https://compliance.admin.ox.ac.uk/individual-rights.

10. **Who has reviewed this study?**

This study has received ethics approval from a subcommittee of the University of Oxford Central University Research Ethics Committee. (Ethics reference: CIA-22HT-057**)**.

11. Who do I contact if I have a concern about the research or I wish to complain?

If you have a concern about any aspect of this study, please contact Tianyu Zhou (tianyu.zhou@education.ox.ac.uk) or Rebecca Eynon (rebecca.eynon@oii.ox.ac.uk), and we will do our best to answer your query. I will acknowledge your concern within 10 working days and give you an indication of how it will be dealt with. If you remain unhappy or wish to make a formal complaint, please contact the Chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter as soon as possible:

The Chair, Social Sciences & Humanities Interdivisional Research Ethics Committee;
Email: ethics@socsci.ox.ac.uk; Address: Research Services, University of Oxford, Boundary Brook House, Churchill Drive, Headington, Oxford OX3 7GB

DEPARTMENT OF EDUCATION 牛津大学教育系

Rebecca Eynon 教授
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周天宇 [教育学研究生]
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教育科技是如何被构建的？一项针对中国教育科技公司从业者的调查

参与者信息表

大学中央研究伦理委员会批准号（CUREC）： [CIA-22HT-057]

1. 简介

我们邀请您参加一个关于中国教育科技公司中的教育科技构建的研究项目。该研究由牛津大学教育学硕士（数字化与社会变革方向）学生周天宇负责，由牛津大学互联网研究所的教授 Rebecca Eynon 监督进行。

在您决定是否参与研究之前，请花时间仔细阅读以下信息，了解这项研究的目的、基本信息和您需要做些什么。如有不清楚的地方或您想了解更多信息，请向我们询问。之后决定是否愿意参加本项研究。

2. 为什么进行这项研究？

本研究通过访谈的形式关注中国教育科技公司的从业人员，以阐明中国公司对教育科技的不同理解、看法和实践。它将从微观角度调查教育科技的构建和生产，通过了解商业组织中实际拥有塑造技术权力的从业者的理解、看法和权力关系，来研究和批判性地评估教育科技可能产生的社会和教育影响。此外，本研究还将考察中国当前关于减轻学生教育负担的政策（即 “双减政策”）在多大程度上影响了从业者的认知变化和未来的教育技术建设。

3. 为什么我被邀请参加研究？

本研究的参与者是目前在中国教育科技行业从业的员工，或近 1 年内曾在该行业从业的员工，包括产品经理、运营经理、教研、工程师、数据分析师等职位。他们都应该至少在 18 岁以上。本研究将招募约 20 名参与者。

4. 我必须要参加吗？

参加不是必须的，您可以自由决定是否参加研究。您可以在不说明理由的情况下退出研究，您可以撤回您为该研究提供的任何信息，但撤回信息的最后期限是 2022 年 8 月 12 日。如果您决定退出研究，你所提供的所有信息、数据和贡献都会被完全擦除。

5. 我需要做些什么？

在这项研究中，你将被邀请参加一次线上访谈。

访谈将完全在网上进行。在了解研究的目的并同意参与研究后，你将收到这份参与者信息表和知情同意书。在阅读并同意参与研究后，你将需要在知情同意书上签名，并将其发送给周天宇（tianyu.zhou@education.ox.ac.uk）。之后，访谈将在约定的时间通过腾讯会议进行。访谈通常将持续 40 分钟。访谈的主题将主要包括您对教育技术的理解和看法、商业利益对教育技术的影响以及双减政策的影响。在征得您的同意后，我们希望对访谈进行录音，以便准确记录我

们的谈话内容。参与者可以在任何时候要求暂停或停止研究活动。访谈记录将以安全的方式保存 3 年，之后将被完全删除。

6. 参加活动可能有哪些好处、坏处和风险？

目前没有已知的风险存在。这项研究的结果将有可能为新兴教育技术的相关政策制定和教育及科技公司治理提供指导。

7. 本研究将收集哪些信息，为什么收集这些信息与实现研究目标有关？

本研究的数据将存储在研究者的加密笔记本电脑和大学授权的 OneDrive for Business 中作为备份。它们将在研究工作出版或公开发布后保存 3 年。

本研究收集的数据包括访谈音频记录、根据音频记录人工转换的笔录、你的联系方式和知情同意书。研究人员和导师将有机会接触到研究数据。研究的结果将主要来自于对笔录的定性分析。

8. 该研究将被发表吗？能否从任何出版物或其他研究成果中识别到我？

研究结果将被写进硕士课程的毕业论文中。所有的数据和信息在储存前都会被去掉可识别的身份信息（包括但不仅限于姓名、公司、职位等）。 我希望得到您的许可在研究结果中直接饮用您在采访中的回答，但并不会表明您的身份。我的论文副本将以印刷品和网络形式存放在牛津大学研究档案馆，在那里它将被公开，以方便在未来的研究中使用。

9. 数据保护

牛津大学是您个人数据的数据控制者，因此将决定您的个人数据在研究中的使用方式。牛津大学将为上述研究目的处理您的个人数据。研究是一项为了公共利益而进行的任务。关于你在个人数据方面的权利的进一步信息，可以访问 https://compliance.admin.ox.ac.uk/individual-rights。

10. 谁审查了本项研究？

本研究已经获得了牛津大学中央大学研究伦理委员会的小组委员会的伦理批准。（批准号：CIA-22HT-057）

11. 如果我对研究有疑虑或想投诉，我应该联系谁？

如果你对这项研究的任何方面有疑问，请联系周天宇（tianyu.zhou@education.ox.ac.uk）或 Rebecca Eynon（rebecca.eynon@oii.ox.ac.uk），我们将尽力回答你的疑问。我将在 10 个工作日内回复疑问，并向你说明将如何处理该问题。如果你仍然不满意或希望进行正式投诉，请联系牛津大学研究伦理委员会主席，他将设法尽快解决这个问题。

社会科学与人文科学部门间研究伦理委员会主席，电子邮件： ethics@socsci.ox.ac.uk； 地址：牛津大学研究服务部，Boundary Brook House, Churchill Drive, Headington, Oxford OX3 7GB

Appendix 3: Written Consent Form

DEPARTMENT OF EDUCATION

Professor Rebecca Eynon
Email: rebecca.eynon@oii.ox.ac.uk
Tianyu Zhou [MSc student]
Email: tianyu.zhou@education.ox.ac.uk

Consent to take part in How is EdTech made? An investigation of practitioners on the constructions of EdTech in Chinese EdTech companies

Central University Research Ethics Committee (CUREC) approval reference: CIA-22HT-057

Purpose of Study: This research focuses on practitioners within EdTech companies in China through interviews to illuminate the diverse understandings, perceptions, and practices around EdTech in China. It will investigate the construction of EdTech from a micro perspective, providing a means with which to examine and critically assess the likely social and educational implications of EdTech by understanding the perceptions, beliefs, and power relations in commercial organisations of the practitioners who have power in shaping the technology. In addition, this study will look at the extent to which China's current policies to reduce the educational burden on students (called "the double reduction policy") have impacted changes in practitioners' beliefs and future EdTech construction.

	Please initial each box if you agree with the statement
I confirm that I have read and understand the information sheet for the above research. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
I understand that my participation is voluntary and that I am free to withdraw at any point until August 12, 2022, without giving any reason.	☐
I understand who will have access to personal data provided, how the data will be stored and what will happen to the data at the end of the project.	☐
I understand that I will not be identifiable from any publications.	☐
I consent to being audio recorded.	☐
I understand how audio recordings will be used in research outputs.	☐
Use of quotations: Please indicate your preference (select *one* option): a) I do not wish to be quoted. **or** b) I agree to the use of quotations in research outputs if I am not identifiable.	☐ ☐

I understand how to raise a concern or make a complaint.	
I agree to take part.	

_____	dd / mm / yyyy	_____
Name of participant	Date	Signature
_____	dd / mm / yyyy	_____
Name of person taking consent	Date	Signature

DEPARTMENT OF EDUCATION 牛津大学教育系

Rebecca Eynon 教授
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同意参加研究项目：教育科技是如何被构建的？一项针对中国教育科技公司从业者的调查

大学中央研究伦理委员会（CUREC）批准编号： CIA-22HT-057

研究目的：本研究通过访谈的形式关注中国教育科技公司的从业人员，以阐明中国公司对教育科技的不同理解、看法和实践。它将从微观角度调查教育科技的构建和生产，通过了解商业组织中实际拥有塑造技术权力的从业者的理解、看法和权力关系，来研究和批判性地评估教育科技可能产生的社会和教育影响。此外，本研究还将考察中国当前关于减轻学生教育负担的政策（即 “双减政策”）在多大程度上影响了从业者的认知变化和未来的教育技术建设。

	如果您同意该声明，请在方框内打勾
我确认我已阅读并理解了上述研究的信息表。我有机会考虑这些信息，提出问题并得到满意的答复。	☐
我已了解我的参与是自愿的，我可以在 2022 年 8 月 12 日之前的任何时候自由退出，而无需给出任何理由。	☐
我已了解谁能够接触到我所提供的个人数据、数据将如何被储存以及在项已目结束后数据将如何处理。	☐
我已了解我不会在任何出版物中可被识别。	☐
我同意在访谈中被录音。	☐
我了解访谈录音将如何在研究成果中被使用。	☐
语言直接引用：请选择你的偏好（勾选一个选项） a) 我不希望我被引用 b) 我同意被直接引用	☐ ☐
我已了解如何提出疑问或投诉。	☐
我同意参加研究。	☐

参与者姓名	日期	签名
采访者姓名	日期	签名

Appendix 4: Semi-structured Interview Guide

- **Information**
  - How long have you worked in the EdTech industry?
  - What is your employment status?
  - What is your educational background (major)?
  - What is your position in the company?
- **Understandings and beliefs about EdTech**
  - Could you please briefly introduce the educational technology you work on?
  - How would you define educational technology?
  - What value do you think technology offers to education and to learners?
  - What do you think the educational technologies currently on the market offer to learners? Is there a gap between this and what you consider to be the ideal educational technology?
  - Has your understanding and knowledge of educational technology changed since you started your career?
- **Economic shaping of EdTech construction**
  - Why do you think the company is investing in the EdTech sector?
  - How do you think business/capital has impacted on educational technology?
  - Do you think there is a conflict between commercial interests and the value of learning? If so, how do you reconcile the multiple interests?
- **The double reduction policy impact on EdTech construction**
  - What impact has the double reduction policy had on your EdTech business?
  - Has the double reduction policy changed your understanding and beliefs about EdTech in any way?

- How do you think EdTech will develop in China in the future?

- **Do you have any other questions? Is there any other information you would like to add?**

Appendix 5: Thematic Map

Table 3
Thematic Map

Research Question	Theme	Codes	Transcript extracts
RQ1: Understandings and beliefs of EdTech	Technology as a tool in education	Technology as a tool	TA-1: "(Technology) provides the value as tools. I first became aware of EdTech when Company H provides with the teaching tablet."
		Technology provides efficiency	OP-1: "Adaptive (technology) will be more efficient in helping students to improve their academic performance."
	Differences in the perceptions of practitioners in different divisions	High degree of division of labour	TA-2: "I do teaching and research, and the illustrations in the coursework I do are things that are made by people who specialise in design, and they just look really good."
		Educational sentiments	TA-6: "We little teaching assistants are there for sentiment because I followed this English teacher and he helped me a lot in my senior year."
		Enter at random as the industry emerges	RD-1: "It was actually a random choice because this (EdTech) was really hot and a lot of people around me were doing it, so I was brought in by them." SA-2: "EdTech was the largest recruiter in the job market at the time."
		Different positions value different things	TA-2: "I want each person to reach his maximum potential and to be able to grow. This is what I think is the essence of education." SA-2: "(Marketing) amplifies what parents are most concerned about, and what parents are most concerned about is grades." TA-1: "Education as I understand it has two goals, one is selection and the other is nurturing. The reason why so many people are now attacking education is that society now places too much emphasis on selection and neglects nurturing."
	Legendary vision with poor technology	Legendary vision	OP-1: "We agreed to rely on Company B's powerful algorithms and technology and the content created by the teacher's... AI classes would be a great thing... It was revolutionary educational technology, and at the time we all thought it was a very grand ideal." OP-3: "Some (personalised and intelligent) visions are described when selling."
		Poor current technology	OP-1: "Although I keep saying we have an artificial intelligence, I am actually the artificial one because the paths are all designed by the teacher." OP-1: "Our products create the illusion of greater efficiency."
		Because of technology maturity	OP-1: "The buried points in the software are the ones you can think of, the more granular data is not available now."
		Because of complexity	OP-1: "There are two worlds on screen and off screen. A student may tap an incorrect option on screen, but the reason for the error may simply be a miscalculation on the last step or a wrong click. But there is no way to identify the root cause of the error on the screen."
RQ2: Economic shaping of EdTech	Pursuit of profit as the main motivation of EdTech company	Large tech company entering for profit	TA-5: "When the leaders met, they repeatedly stressed when we would be profitable." OP-4: "In terms of the company's decision making, it's more concerned with how to invest in the business... We reported that we expected the product to make $10 million a year, which we thought was massive, but the company would think you had no room to grow."

			OP-1: “It's normal for Company B to do anything. 2020 is such a hot year for online education and he will definitely invest in such a high-growth industry.”
		Large tech company entering for CSR	OP-1: “All companies have to do CSR, partly for the government, seeking its support and assistance, and partly for the public.”
	Index-oriented incentive program shaping the design of EdTech	Satisfaction, renewal rates and other indexes	TA-1: “The widespread start of doing renewals (meaning making renewals the goal of the work) would only have started at the end of 2012.” OP-1: “We aim for both renewal and completion rates.”
		As the assessment and incentive program	TA-2: “(Online education teacher) Performance is linked to salary increases… If you have the highest performance for 4 consecutive periods, your salary can be doubled at the maximum.”
		Attitudes towards incentive program	TA-2: “For people like me (who don't care much about performance), there are two reasons, one is because of the limited salary increase for teachers, and the other I value more than the development of my own abilities through online education.”
	Profit-driven design contributing to the quality of education	Educational outcome and indexes	TA-1: “... A student needs continuity in learning, he can only improve his grades if he studies continuously... The essence of this matter is to look at the results.” TA-1: “When I first started teaching online classes the teachers basically didn't care about the students' results... But then after they started doing renewals, the teachers gradually started to understand this whole education thing.”
		Comparison with public schools	TA-2: “In public schools, the quality of teaching is not directly linked to individual performance and parental satisfaction.” TA-3: “Those of us who are teachers in the company make our living by teaching, you get paid for teaching well, you don’t get paid for teaching badly. School teachers have iron rice bowls (secured job) and they have no incentive to constantly improve their teaching quality.”
	Profit-driven design compromising between business interest and educational outcome	Compromises	OP-1: “It (the technology) could have served the learner better, but there are compromises because of the pressure to submit to commercial profitability, or some pressure for personal performance. This is all the time, at every turn.” SA-2: “For the teacher himself, he needs to strike a balance between his educational philosophy and his financial interests, or his own KPIs.” TA-3: “Teachers are also miserable. Many of my peers work as teachers in internet institutions and they have to rank conversion rate once a week and then the last place is eliminated. Some teachers told me they can even take their clothes off in class if the students sign up for the lass.”
		Free trail classes	SA-1: “The $20 free trial class consists of 10 lessons, 4 in Chinsese, 4 in Math and 2 in English. Three of the lessons are live and the others are recorded. Parents are usually told that the $20 is for a set of materials to get the lessons free, and the materials include tutorials, books, pens and some other free items.” TA-1: “Free trial lessons are the main indicator used by institutions to assess teachers, and everyone is talking about deceptive free trial lessons.”
		Capital encourages compromises	OP-1: “Our goal is renewal rates. So how do you stimulate the renewal rate of your users? Well, you must make the student feel that he hasn't studied enough... You divide one knowledge point into ten lessons to sell.” SI-2: “(Criteria used by investors to screen education projects) The first is revenue synergy and the second is cost synergy.”
		Unsatisfaction with the compromises	TA-1: “The point where I have a hard time balancing this is mainly because I need to say some pretty big words in class and it can be hard for me, but I can't help it, I say what I say.” TA-5: “The EdTech industry is not really doing education.”

	Profit-driven design leading to chaotic situations in the industry	Too many ads	SI-2: “The billions raised by several top companies at the time were almost all invested in advertising.”
		False ads	SA-1: “It (Ads) tells you that you don't need to do problem sets, you can get all the questions right in 5 seconds by listening to my lessons... Do a lot of sales stuff in free trail lessons and then do the main lesson (the sales).”
		Chaos starts from capital in-flow	SA-1: “Like companies M and Z, they started out with an injection of capital because they lacked the upfront build-up and then had to expand like crazy, and then they would expand and acquire students in a variety of ways.” SA-2: “K-12 education is a little more restrained, but if you go to adult education, it will have a lot of instalment loans (microcredit) for students to pay their tuition fees in advance.”
RQ3: Political shaping of EdTech	General positive on the direction of policy	Changing direction	SI-2: “Government policy clearly wants you to use the money you raise to polish your product (technology).” OP-2: “… (Business transformation) to offline schools to help public and private schools to improve the efficiency of teaching and learning.”
		General agreement	TA-2: “Overall it is a good thing. Why? Because it has put a baton on the schools.” OP-1: “Those who want to make a quick buck but don't really want to do education, that part will be removed. This is definitely good for the overall environment.”
		Back to the essence of education	SA-1: “This may avoid a lot of unhealthy competition and enable a real return to education itself.”
	Failure to address the structural issues with unclear future of EdTech	Structural issues	OP-1: “I don't think the anxiety of Chinese parents can be killed off by saying that you have a policy, unless you say that the Gaokao will no longer be graded.”
		Black-market	SA-1: “This makes the inequity even worse for those who are financially well off, who still have the means to find better education.” TA-2: “This market becomes uneven and it becomes even more dark.”
		Unclear future	SA-1: “But it's really just a case of changing the appearance, with Chinese lessons becoming literature lessons and Math lessons becoming thinking lessons...”
Others	Business information	Business information	OP-1: “At the time I was doing an AI recorded lesson software in high school science... The teacher recorded a video of the lesson and the students accessed different learning paths on the software by clicking and filling in the blanks and other on-screen interactions.”
	Personal information	Personal information	TA-1: “I used to work part-time as a teaching assistant at Company X, first when I was at university.” TA-2: “I left the EdTech industry last year almost in September last year.”