School Case Study Report

UNESCO International Research and Training Centre for Rural Education

Contents

School Case Study Report-Beijing First Normal Affiliated Primary School

School name	Beijing First Normal Affiliated Primary School	
Local researchers	Baoping Li/ Weng Xin/Yifan Lu	
Researcher contact details	Email: luyf@inruled.org	Telephone: +86(18519522768)
Interviewees	**Type of interviewee**	**Information**
	School leadership	Teacher X (F), vice-principal Teacher Y (F), leader of English educational research group
	Technology coordinator	Teacher Z (M), IT Coordinator
	Teachers	Number of teachers interviewed: 4 Subjects they teach: Teacher A (F): Chinese; Teacher B (F): Art; Teacher C (F): Math; Teacher D (M): Math; Years of teaching: Teacher A (F): 6 years; Teacher B (F): 29 years; Teacher C (F): 10 years; Teacher D (M): 5 years;
	Students	Number of students interviewed: 5 students Grades/Years of the students: Student A: 5th Grade(M) Student B: 6th Grade(F) Student C: 6th Grade(F) Student D: 6th Grade(F) Student E: 6th Grade(F)

General Information about the School

School address	Dongcheng District, Beijing, China
Contact information	N/A
Basic information about the school	
Public or Private?	Public
When was the school established?	1957
Vision of the school	The vision of the school is to create confident, mindful, responsible, and happy individuals that contribute.
Number of students (Female/Male)	1897
Number of teachers (Female/Male)	Around 135
How many non-teaching staff? (F/M)	/
Average class size	37
Community context of the school	
Geography	Beijing First Normal Affiliated Primary School is in Dongcheng District, which is in the eastern part of downtown Beijing, China, covering an area of 41.84 square kilometers. The area has the highest concentration of cultural relics in Beijing with a total of 164 cultural relic protection units, among which, 37 are state-level, 69 are municipality-level, and 58 are district-level (Dongcheng District People's Government of Beijing Municipality, 2021). The school is in Tiantan subdistrict, famous for the Temple of Heaven, one of the 17 subdistricts of Dongcheng district, and is to the south of the Temple of Heaven with a river separating the two.
People/ demographics	As of 2020, Dongcheng District had a total of 709,000 residents, comprising 285,543 households with female residents (364,916) just outnumbering male (343,913). The figure for age group 0-14 years is 98,290 representing 13.9% of the whole population in the district (Dongcheng District People's Government of Beijing Municipality, 2020). The 17 sub-districts under the jurisdiction of Dongcheng District have permanent populations as follows: >100,000 1 subdistrict 50,000-100,000 3 subdistricts 10,000-50,000 12 subdistricts <10,000 1 subdistrict The Tiantan subdistrict where the school is located has a permanent population of 27,429 (Dongcheng District People's Government of Beijing Municipality, 2020). Due to its geographic location within the cultural relic protection units, the population of Dongcheng District enjoys traditional Chinese culture.

Economy and industry	In 2020, the GDP of Dongcheng District reached 295.47 billion yuan. The top three contributing industries were the financial sector (30.7%), information transmission, software and information technology services (11.0%), and scientific research and technology services (10.9%), showing that the financial sector and technology play vital roles in Dongcheng District. As of 2020, Dongcheng District citizens earned an annual per capita income of 83,501 yuan and annual per capita expenditure was 46,190 yuan (Dongcheng District People's Government of Beijing Municipality, 2020). The students' parents consist of factory workers, entrepreneurs, and unemployed residents with basic living allowances. Dongcheng District People's Government is dedicated to improving the wellbeing of people in Dongcheng District. According to the interview of leaders from Beijing First Normal Affiliated Primary School, the community near the school was a shanty town 3 years ago and is currently under reconstruction with large-scale construction sites nearby. The economy will improve and industry will be diversified after the reconstruction.

Technology Uses and Impacts

Teachers

Instructions

The teachers at Beijing First Normal Affiliated Primary School used their knowledge of the subject matter, teaching, and technology to facilitate experiences that advanced student learning in both face-to-face and virtual environments. For example, teachers initiated the *Digital Storytelling Project[1]* class. The key technologies for this class were the Honghe[2] electronic whiteboard, Honghe pads, and dot matrix digital pens[3]. The Honghe electronic whiteboard enables teachers to maintain interactive classes with its education tools kit. Honghe pads and dot-matrix digital pens are used by the students; the pads to read PPTs and other materials, and for shooting videos; the pens for writing. The Digital Storytelling Project class facilitates students to define their research questions in real life, find solutions in groups and present results in class.

Teacher D (M) shared his experience of using the Honghe electronic whiteboard (Figure 1), Honghe pads (Figure 2), and dot matrix digital pens (Figure 3), in teaching how to calculate the area of a polygon. He divided the class into 6 groups and

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[1] Digital Storytelling Project requires students to be divided into several groups. Each group chooses one research topic, records the research process, and finally makes a story video and presents it in class.

[2] Honghe is a tech company that provides various interactive education products, such as interactive whiteboards and pads. More information can be retrieved from its website: http://www.honghe-tech.com/.

[3] The dot-matrix digital pen is a new writing tool that writes on special papers. These papers are printed with a layer of an invisible dot matrix pattern. When a digital pen writes on these papers, the high-speed camera at the front of the digital pen captures the movement track of the pen tip. Meanwhile, the pressure sensor sends the pressure data back to the data processor, and finally transmits the information through Bluetooth or USB cable. The pen can be used to collect students' data and also help students share their work in real-time.

encouraged each group to choose a real-life situation. For example, when designing parking spaces for parking lots, what kind of shape (parallelograms or rectangles) could best utilize the space? If we have a rectangular plot where we intend to plant a flower garden in the parallelogram formed with vertices at the midpoints of the length and width of the plot, how can we calculate the area of the garden? These were just two examples from teacher D. Students were encouraged to choose their research questions, measure, and record data throughout the process using Honghe pads and dot-matrix digital pens. Working in groups, students discussed and developed a script for a digital story, allocated the respective roles for each group member, and finally each group showed their video on the Honghe electronic whiteboard and answered questions from teacher D and classmates. During the discussion, students strengthened their understanding of the area of a polygon and practiced soft skills. The whole process is student-centered, Teacher D was more in the role of guiding and supporting. He explained the logic and flow scheme of the digital storytelling activity at the beginning and divided the class into groups, providing support when necessary.
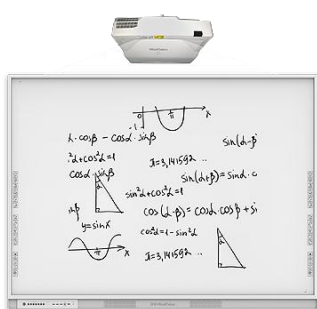
Figure 1: Honghe electronic whiteboard

Figure 2: Honghe pad

Figure 3: Dot matrix digital pens

Teachers at the school utilized innovative Honghe electronic whiteboards, Honghe pads and dot matrix digital pens to help students of the Digital Storytelling Project class to enhance their critical thinking, creativity and curiosity. Students were able to use these technologies and devices to help further explore their research questions. The project was carried out in the form of group learning, the whole learning process was recorded, and with the help of technology, the materials were edited into a digital story.

The teachers found that using these technologies had several advantages and disadvantages. Digital Storytelling is a visual storytelling method that combines the elements of a story with multimedia tools (pictures, sound, video, animation, and web pages).   Digital Storytelling Project class is an innovative, student centric, educational method that breaks the conventional classroom model where teachers teach and students listen, so that teaching is no longer just imparting knowledge, but also understanding. The process of making and applying digital stories exercises

students' knowledge and skills and comprehensively develops their overall literacy. The whiteboard has a function that enables teachers to randomly choose a student to answer a question, which excites students and makes them concentrate in class. As an incentive, students who answer a question correctly can gain extra points which are displayed on the whiteboard. Overall, the Digital Storytelling Project class can improve students' academic performance, help students understand the application of knowledge, and promote a positive emotional change of attitude towards learning and overcoming difficulties. However, teachers also mentioned this project was very time-consuming considering the size of the class, and it would be simply impossible for them to use this instruction method in every lesson.

Inclusive learning experiences

Inclusivity is important to the teachers at Beijing First Normal Affiliated Primary School, and the diverse learning needs of the students were met by the customized and personalized learning activities of the Digital Storytelling Project class. To illustrate, all four teachers (both male and female) allowed the students to choose their research topics. Then the students were divided into mixed gender groups where they discussed and negotiated role allocation, and clarified which team members were responsible for which tasks. For example, some are responsible for collecting information from the Internet or books, or preparing scissors and colored paper, while others are responsible for filming and recording the research process, explaining the research process by hand, or editing and making videos. All students used digital devices (Honghe pads and dot-matrix digital pens) to record discussions promptly.

As all teachers (both male and female) mentioned, students who are good at using technology can play a leading role in class. For those students who are not acquainted with technology, teachers spent extra time training students in advance, and also invited IT teachers to explain the use of technology to ensure that all students had no difficulties in using the whiteboard, pad, and dot matrix digital pens. According to the teachers, there is no significant difference between boys and girls regarding the acceptance and learning speed of the whiteboard, pad, and dot matrix digital pens.

Digital literacy

The teachers at Beijing First Normal Affiliated Primary School exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society. All four teachers (both male and female) recognized the positive effects of the Digital Storytelling Project class on students' learning. They actively explored new ways of teaching with the Honghe electronic whiteboard, Honghe pads, and dot matrix digital pens.

Furthermore, teachers at Beijing First Normal Affiliated Primary School

collected student data and adjusted their teaching accordingly. For example, teachers can get diagnostic reports from the Honghe products. The Honghe pads have an assessment tool that goes beyond multiple-choice responses. Students can respond to questions and assignments by typing, drawing, or submitting images to show their answers. A key feature of the Honghe pad is that it offers real-time intervention so teachers know exactly what their students need and can take immediate action. By reading these reports, teachers can gain a complete picture of teaching and learning and modify teaching plans accordingly. Apart from the Honghe products, teachers can also get data from the dot-matrix digital pens. By analyzing the data from the pens, teachers can understand the students' learning process and adjust teaching as required.

Professional growth

By promoting and demonstrating the effective use of technology, the teachers at Beijing First Normal Affiliated Primary School continuously improve their professional practice in their school and professional community. To illustrate, teachers themselves hold vibrant workshops, often watch and evaluate each other's lessons, and schools often invite teachers from universities and tech people from Honghe to deliver training programs to teachers. Additionally, teachers have abundant opportunities to attend teaching and research activities organized by the school, the grade group, and also by the municipal government.

There are various workshops with titles such as data story, co-teaching, smart classroom, data-driven, and minicourse. These workshops are categorized mainly by research interests and learning modalities. In the workshop, teachers share their experiences using technologies. For example, teacher D (M) is the owner of the data story workshop, he organizes the offline workshop once a month and, at the same time, the theoretical learning is constantly available online. The only concern is teachers don't have enough time for teaching and research. Teacher D (M) said, "Every time we gain new experience with technologies, we will share with our grade group and the whole school, and try to encourage more teachers to participate in our projects".

To get support for their use of these technologies, the teachers at Beijing First Normal Affiliated Primary School often collaborate with Honghe and universities. For example, tech people from Honghe come to the school and train teachers, but often the training provided by commercial companies (e.g. Honghe) is general, and not targeted at fixing their teaching and learning pain points. Therefore, the school is now working with Beijing Normal University to develop a teaching and learning system where teachers can prepare tests and upload them onto the platform. Students can go online, click and complete tests. In the background the system will record all data and track the thinking process of students, providing students and teachers with diagnostic reports. Students can self-check, teachers can follow the students' thinking process and see which knowledge points need further work. This can facilitate teachers to modify their teaching method.

Students

Technology operations and concepts

Generally, the students at Beijing First Normal Affiliated Primary School demonstrated a basic understanding of technology in their learning experiences. They can apply digital tools to gather and use the information to help their learning, and they can also use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and working and contribute to the learning of others. They were familiar with the use of the Honghe whiteboard, Honghe pad, and dot matrix digital pens, and they were able to record micro-lectures with digital devices and navigate video editing and photoshop software. The micro-lecture serves as a kind of instructional content that is formatted for online and mobile learning. Students have also demonstrated a basic understanding of micro-lectures (short-record audio or video presentation on a single, tightly defined topic) in their learning experiences. They are encouraged to produce micro-lecture videos based on their understanding of a topic and establish a self-directed model of learning.

The students interviewed (four boys and one girl) felt that they were equipped with sufficient abilities to use technology for their studies and learning, but to be proficient in technology, they still need more time to practice and have more systematic training. In terms of the amount of time given to them to use technology, they stated that it's the right amount of time, the learning process is not taking too much time nor affecting their normal learning routines.

The students feel that micro-lectures, Honghe whiteboard, Honghe pad, dot matrix digital pens, and video editing and photoshop software usage at school are relevant to their future projects and work. For example, student A stated that the skills of editing videos, pictures, and the ability to explain certain topics logically which he acquired from making micro-lectures would be beneficial for his future projects and work.

Creative and Critical Learning through technology

The students interviewed demonstrated creative thinking, knowledge construction, and innovative product development skills when designing digital storytelling projects. Students were formed into groups and conducted a short research project about "saving water". They were asked to gather information from different sources and record information in a graphic organizer or Excel. Students were formed into groups and researched the same topic. Student D stated "At first, our group did some research about water conservation and gathered information about this topic together. We found some data from both our books and the Internet, and we used Excel to make a pie chart and a bar chart out of the data. To present our work, we made a PPT together, we showed the information we found and presented our charts on the Honghe whiteboard so that everybody else in the classroom could also see it,

and we even drew a picture together about saving water to show our classmates that water is really important to us." Project-based learning provides students with a first-hand learning experience to navigate and explore technology tools. Students reported that they felt more fun and enjoyment and gained a sense of satisfaction when they successfully presented their group work to their classmates. Multimedia display enabled them to express their ideas more freely and more innovatively. After students presented their project, teachers handed out the Honghe pads to the students and provided a list of questions for students to answer. Students can also use this opportunity to raise questions and discuss with their peers and teachers.

Another subject discussed in the interview was game-based learning where students were instructed to play a tablet-based mathematics game called Wuzzit Trouble which is played on the Honghe pad by interacting and dragging things on the interface. "Wuzzits" are variously colored creatures that have been trapped in cages in a castle. The goal of the game is to free the Wuzzits by obtaining all the keys. Players must rotate one or more small cogs to move the large gear wheel, which then causes the keys to move, and finally, obtain the keys. During gameplay, no problem-solving support or feedback is given in the interface. Teacher scaffolding was provided during the process, and the interviews suggested that the integration of teacher scaffolding into digital game-based learning can have an important effect on students' learning and development in mathematics in primary education. Students reported that this new form of learning through game playing elevated their interest in mathematics and increased their willingness to learn. Notably, the way the game is designed positively affects their emotions, and despite difficulties, stimulates them to think independently and explore.

Figure 4: The Wuzzit Trouble game interface

Communication and collaboration

Technology tools enabled students to work collaboratively with their classmates

through various forms and channels. For instance, student C stated that he would use his mobile phone to share the micro-lectures he made with his classmates so everyone could have access and they could share their ideas, insights, raise questions and have a discussion if required.

Another example regarding communication and collaboration is the group project called "Digital Storytelling". Students were formed into groups and asked to choose from several parks and map the park they liked the most. Student B's group chose to map the new Universal Studio in Beijing. They were asked to use directional markers to measure distances, draw pictures to show the layout of the park and use multimedia technology to present the group's work. The final product of their work was a full display of all the elements of the park organized clearly and logically. During the process, they needed to talk constantly to each other, give feedback about each other's work, and adjust their work plan. In terms of the presentation of the project, they also needed to come up with a plan to assign different tasks so that each of them could have a role to play during the presentation.

Students are encouraged to use PPTs or other kinds of multimedia to present their projects and ideas, using the Honghe whiteboard to show their group work to the rest of the students. In the meantime, students also have access to Honghe pads, and they get to decide whether or not to use the pads to present their ideas.

Figure 5: Digital Storytelling Presentation

Impact on learning

Generally, the students at Beijing First Normal Affiliated Primary School reported that technology had a positive impact on their learning experiences. The students expressed that by using the Honghe pad, Honghe whiteboard, and open educational resources they have progressed academically and increased their enjoyment of learning. Students reported that they are motivated by the increased

efficiency of class since teachers no longer need to handwrite everything on the blackboard, saving a lot of time for both teachers and students, and increasing the educational productivity. Teachers can focus better on the needs of individual students. Students also feel that their presentation and oral skills have improved during the process of recording micro-lectures and digital storytelling and it's fun for them to exchange ideas and insights through this technology. Their imagination and creativity have also been increased during this learning process.

However, students also encountered difficulties and challenges when learning new technology tools. For instance, Student C stated that he could only use one of the features of the Photoshop software at first, and he met some difficulties in editing and formatting the pictures. He couldn't crop the size of the pictures into the form he wanted, and he couldn't find the right way to balance the tone and color of the pictures. When students are just starting to learn to interact with a new technology or software, they naturally experience some challenges or issues, but teachers, classmates, or parents can always step in and help them resolve the issues.

Factors and Conditions for Success

Technology

Hardware/ software/ infrastructure

To successfully implement the Digital Storytelling Project, Beijing First Normal Affiliated Primary School had to ensure the hardware, software, and infrastructure environment needed for effective technology integration. The school is equipped with a high-speed Wi-Fi connection. Each classroom has a Honghe electronic whiteboard, some Honghe pads, and dot matrix digital pens. The IT coordinator is in charge of installing the commonly used apps into the hardware, e.g., pads. The main selection criteria are that they are easy to use, easily integrated into the existing tech environment, and in common use.

There are several challenges that the school has faced in sourcing apps. For one, many apps are too general and teachers have additional requirements which carry extra cost. Compatibility is another issue. A teacher may find an Apple app which is suitable for a class, however since the school uses the Huawei system, the app is simply just not compatible.

Costs and financing

There are various costs associated with technology integration in the school, including Wi-Fi connection, maintenance cost, electricity cost, etc. The financing arrangements to pay for these costs are mainly from the municipality and district governments' financial support. The school first reports the budget plan to the government, and funds are then given to the school after approval. Usually new tech

products have a three-year warranty, so the maintenance cost of new products is covered by warranty. However, once the age of a product exceeds the three-year warranty period, the maintenance cost will then be covered as an administration cost.

The school faces some challenges and difficulties in securing the funds required for technology integration. For example, the municipality and district governments don't necessarily approve the budget amount and often the funds given are lower than the required amount.

Maintenance

Beijing First Normal Affiliated Primary School sets up, keeps up, and maintains the hardware, software, and infrastructure in two ways. First is to seek help from Teacher Z - the IT coordinator, and secondly is to seek help from the service personnel at Honghe. There are several challenges in setting up and maintaining the hardware, software, and infrastructure in the school. For example, the equipment at school ages quickly. In the grade one and two classrooms, the students cannot see the Honghe electronic whiteboards clearly. This is due to a lack of funds, which need approval from the education commission.

The school has put in place a protocol to ensure defective hardware, software, and infrastructure are reported promptly in the following manner. First, teachers report to the IT coordinator. If the problem is not fixed, then the IT coordinator will contact the tech person from Honghe.

Security

Beijing First Normal Affiliated Primary School addresses physical and data security in various ways. For example, when the school chooses an educational app, the school will refer to the list of apps released by the Ministry of Education. Currently, there are more than 200 apps on the list which are recognized by the Ministry of Education. When the school considers an app, it will first examine and verify the app, then sign a confidentiality agreement with the tech company to ensure the data cannot be released. The pads are used for all subjects and it is the responsibility of the relevant subject teacher to take away the data and ensure that the data in the pads is wiped clear. In its technology implementation the school considers and addresses the diverse needs and circumstances of students. The school follows the national and municipal regulations regarding tech implementation and has its own regulations on tech, classroom, and computer management. Regarding vulnerable students, the district government stresses and requires that the school have teaching plans for inclusive education. The school has relevant teachers responsible for making such plans.

School

Governance and Regulations

The Chinese education informatization policy was driven by three factors: the promotion of education informatization 1.0 in China, the requirement of education modernization toward 2035, and the response to "Smart Education." The framework for action can be summarized as "One Goal, Three Tasks, and Eight Actions." China began to implement the "Modern Distance Education Project" at the beginning of 1999 and underwent tremendous changes from scratch, focusing on top-level design in the two decades after the millennium. According to the "2003-2007 Action Plan for Invigorating Education" approved by the State Council in March 2003, the "construction of ICT in education" was incorporated into the six big projects; the CPC Central Committee and the State Council issued the "Outline of the National Medium and Long-Term Program for Education Reform and Development (2010-2020)" in July 2010, making clear for the first time the revolutionary impact of information technology on educational development; the MOE issued the "Ten-year Development Plan for ICT in Education (2011-2020)" in March 2012, demonstrating basically formed strategies and general arrangements for China's ICT in education in the context of informatization; it further issued the "Action Plan 2.0 for ICT in Education" in April 2018, proposing to reach the goal of ICT in education, namely "e-teaching apps covering all teachers, e-learning apps covering all the school-age students and digital campus covering all schools, as well as generally improving the level of harnessing information-based tools, strengthening teachers and students' information-based competence and building an 'Internet plus education' platform". The main features involve innovation-driven development rather than technology-driven development, committing to the expansion of digital educational resources rather than the digital presentation of textbooks, and aiming at improving teachers' and students' information literacy rather than the applied skills of information technology. The future vision of the plan involves building new models of talent cultivation, education service, and education governance. The school has mainly adopted and integrated the national documentation and regulations into their school's work, and they have customized school regulations for information technology, such as the use of information technology classrooms.

Decisions around technology are usually made by the Principal, Chief IT Coordinator, and Program Directors. The decision to introduce any kind of new technology in school needs to consider the following factors:

1) cost-related factors
2) alignment with technology plan or school vision
3) the impact of technology on instruction and student learning.

The school provides regulations and maintenance plans on the use of smart classrooms and other relevant equipment. The school has also established general requirements for using enabling technologies and technology furniture in daily teaching activities. As for the key issues on security and ethics of technologies, the

school adopted the white list of apps announced by the Ministry of Education (MoE), and they have a strict mechanism to ensure adherence to the MoE norms and guidelines. Students' personal information was secured and protected by the confidentiality agreement between school and technology companies.

Capacity development

Beijing First Normal Affiliated Primary School prepares and supports its staff and teachers for new technology integration through continual professional development. The school has established special training courses for teachers on the topics of development of ICT in education as well as educational ideas and concepts regarding ICT. In terms of the usage of new information technology equipment, training courses are organized whenever a new piece of equipment is purchased. The school also holds different ICT in education workshops regularly, such as smart classroom pedagogy, high-quality micro class teaching, and distant learning workshops.

The school leadership involves teachers in planning for continual professional development on ICT in education in the school. Teachers are encouraged to take different training courses and workshops and are offered plenty of opportunities to find their passion and interests. The theme of one workshop is the essential smart classroom tools and how to collect and analyze data through these tools. Besides the training courses, some school teachers would voluntarily take the responsibility of organizing co-learning workshops. Teachers would present themes and concepts related to ICT in education, or present a practical skill related to the use of technology in class and share it with the rest of the teachers. In the past 3 years, the school provided continual professional development courses on new technologies like digital learning tools, online learning materials and resources, smart classroom tools, and other kinds of regular in-service training, workshops, local and national conferences, and college courses.

Learning Culture

Beijing First Normal Affiliated Primary School actively works to nurture and promote a strong learning culture where new technologies are infused. The school regularly holds workshops and seminars regarding ICT in education, and the training and development plans are open to all the teachers in the school. The training is formalized and taken seriously, and as a result, teachers who have successfully learned or shared new technology skills are recognized and encouraged. Their ability to use ICT in education will be evaluated and assessed during the regular class evaluation organized by the school's Department of Class Evaluation which is responsible for the curriculum development, approval, and evaluation of classes. Teachers who have taken the training and demonstrated their abilities to incorporate technology with teaching will be recognized by the Evaluation Group. Knowledge

and information sharing have also been formed into a formal process. A knowledge sharing and management system has been established in the school, templates and frameworks are provided to the teachers, and they are encouraged to upload and share their instructional resources, teaching materials and lesson plans to the system. A school-based resource library was also established under the support of the school. The school principal and management encouraged teachers to upload their individualized educational resources by providing cash bonuses for high-quality resources, and the resources library now has more than 600 micro-lectures and courseware PPTs.

The school also has an Audio-visual Center, which is responsible for the maintenance and management of the equipment in each classroom. The working staff in the center are also responsible for the in-house coaching and mentoring of the use of new equipment, but they are also responsible for inviting experts or equipment manufacturers to organize training courses for school teachers. The school's Audio-visual Center has special funds available to organize training courses and is able to provide expert fees for the training and workshops.

The school also supports its teachers and students to create or adapt digital content, resources, and tools to improve their teaching and learning. For instance, they have teaching and research groups based on different subjects. The group will prepare and review teachers' lesson plans together and share educational resources like instructional games, courseware, and micro-lectures. Teachers are free to exchange ideas and insights regarding the technology tools and resources they use in class to better adapt their traditional teaching skills to a multimedia environment, and the regular collective lesson preparation provides them with the best opportunity to share their experiences and insights. The collective lesson preparation usually takes place weekly or at the beginning of each new lesson. Teachers would take this opportunity to discuss the syllabus and share their experiences of best practices of technology uses and impact on students.

External partnership and support

In 2012, China announced its first plan addressing ICT in education: the Ten-Year Development Plan on ICT in Education (2011-2020). The Plan contains the "Three Connections, Two Platforms" initiative, which refers to broadband connections in every school, connections to high-quality resources in every classroom, connections to online learning spaces for every student, and the two public-service platforms of educational resources and education management. Government's and schools' efforts over the past years have allowed schools to begin to build a wide-ranging and multi-level system of ICT in education, all aspects and indicators of which have seen exponential growth. Rates of Internet access in primary and secondary schools nationwide have increased from 25% to 88%, the proportion of multimedia classrooms has risen from 40% to 80%, the number of computers per 100 pupils in primary and secondary schools has grown from 8 to 12, and the number of

online learning spaces for teachers and students has surged from 600,000 to more than 63 million. Because of the policy implementation, the expenditure on technology equipment of Beijing First Normal Affiliated Primary School mainly comes from the annual government expenditure on education, both from the municipal and district governments. District governments are responsible for the equipment purchases and they may match different suppliers and vendors with different schools, with the school having little autonomy in this matter.

But Beijing First Normal Affiliated Primary School is exploring the mode of "school-enterprise cooperation". They rely on the technical support of Honghe to assist them with teachers' training and developing equipment usage profiles. Since Beijing First Normal Affiliated Primary School is one of the most influential schools in the district, tech companies like Honghe are naturally drawn to establish cooperation and connections with the school, and the dynamics form a virtuous circle between these two. As a school with high teaching quality, a willingness to experiment and try out cutting-edge technologies, the school provides a great environment for Honghe to test their products and get feedback and suggestions to further improve their products.

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School Case Study Report-Xitian Gezhuang Middle School in Miyun District

School name	Xitian Gezhuang Middle School in Miyun District	
Local researchers	Baoping Li/ Weng Xin/Yifan Lu	
Researcher contact details	Email: luyf@inruled.org	Telephone: +86(18519522768)
Interviewees	**Type of interviewee**	**Information**
	School leadership	Teacher X (F), Dean of Studies Teacher Y (M), Dean of Studies
	Technology coordinator	Teacher Z (M), IT manager
	Teachers	Number of teachers interviewed: 3 Subjects taught: Teacher A (F): Morality and Rule of Law; Teacher B (F): English; Teacher C (M): English; Years of teaching: Teacher A (F): 1 year; Teacher B (F): 3 years; Teacher C (F): 30 years;
	Students	Number of students interviewed: 6 students Grades/Years of the students: Student A: 9th Grade(M) Student B: 9th Grade(M) Student C: 9th Grade(F) Student D: 9th Grade(F) Student E: 9th Grade(F) Student F: 9th Grade(F)
	Others	Please specify: N/A

General Information about the School

School address	Miyun District, Beijing, China
Contact information	N/A
Basic information about the school	
Public or Private?	Public
When was the school established?	1956
Vision of the school	The school was established in 1956 as a primary school, converted to a middle school in 1972, transformed into a vocational school in 1983, and switched back to a middle school in 2001. The vision of the school is love, respect, and balance, bringing harmony to students and teachers.
Number of students (Female/Male)	500 (200 Male: 300 Female)
Number of teachers (Female/Male)	68 (20 Male: 48 Female)
How many non-teaching staff? (F/M)	16 (12 Male: 4 Female)
Average class size	26
Community context of the school	
Geography	Xitian Gezhuang Middle School is in Miyun District. The district is situated in the northeast of Beijing, the capital of China, covering a total area of 2,229.45 square kilometers (Beijing's largest district). It has 2 sub-districts, 17 towns, and 1 village (regional office) with the district government seatlocated in Gulou Subdistrict. As the easternmost point of Beijing Municipality, Miyun borders Hebei province to the north and east as well as the Beijing districts of Pinggu to the southeast, Shunyi to the southwest, and Huairou to the west. In the center of the district is the Miyun Reservoir with a maximum water surface area of 188 square kilometers and a maximum storage capacity of 4.375 billion cubic meters, it plays a significant role in supplying drinking water to Beijing. There is also a section of the Great Wall, Simatai, a popular tourist attraction in Miyun District, and the Nanshan Ski Resort, one of the largest in the country. Being one of China's national ecological zones, the district has 73.63% forest coverage and is world renowned for its recreation and suitability for living. The number of days when the air quality is of or better than Grade II has remained above 80% for four consecutive years. The negative oxygen ion content in the air is 40 times higher than that in the urban area, the ecological quality ranking No.1 of the whole city.
People/ demographics	At the end of 2020, the permanent population of Miyun District was 528,000. Male residents (270,000) outnumbered female (258,000). The figure for age group 0-14 years is 67,000 representing 12.7% of the whole population in the district (Miyun District People's Government of Beijing

	Municipality, 2021). Miyun District is Beijing's famous "Home of the Longevity", with more than 600 elders over 90 years old.
	As of 2020, Miyun District citizens earned an annual per capita income of 39,282 yuan and annual per capita expenditure was 24,262 yuan (Miyun District People's Government of Beijing Municipality, 2021).
Economy and industry	According to preliminary calculations, the district's GDP reached CNY 33.86 billion in 2020. Industry, construction, and real-estate sectors respectively contributed 15%, 10.2%, and 22% of the total GDP. The remaining sectors all contributed less than 10% of the total GDP (Miyun District People's Government of Beijing Municipality, 2021).

Technology Uses and Impacts

Teachers

Instructions

The teachers at Xitian Gezhuang Middle School in Miyun District use their knowledge of the subject matter, education and technology to facilitate experiences that advance student learning in both face-to-face and virtual environments. For example, teachers use *seewo*[4] whiteboards (Figure 1) to help students better understand the knowledge.

Figure 1: seewo whiteboard

Generally, teachers at Xitian Gezhuang Middle School in Miyun District use the seewo whiteboard with PPTs. The whiteboard has a game function where teachers can add subject contents, so students can learn while having fun. For example, teacher A (F) had a lesson on school regulations for the students in grade 7. She listed some behaviors that aligned with the school regulations and some improper behaviors, then

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[4] seewo is a tech company that provides various interactive educational products, such as interactive whiteboards, EasiCamera, feedback devices and related apps. More information can be retrieved from its website: https://www.seewo.com/.

added them into the game function of the whiteboard. She divided the class into two groups and, one at a time, students from each group came up to select a proper behavior on the whiteboard. Each one who answered correctly would gain a point. The rest of the students also looked at the screen and helped the student make the right choice. By playing a game in class, students were excited and immersed themselves in the game, however it didn't take long to calm them down and continue the teaching and learning process. There is little difference between girls and boys regarding new technology in class. Boys are more active and curious and they learn to participate in any activities. Girls are quieter but it doesn't mean they cannot learn with technology. "They just don't actively engage because of their natural personality", said teacher A (F). Based on the precept that boys are active learners while girls are inactive learners, teacher A (F) often first demonstrates the application of the seewo whiteboard for the students, then invites some active boys to set an example for the other students, and after that she would encourage more girls to participate. Overall, students are good at accepting new things. Teacher C (M) shared his experience with using PPTs. Before teaching new words (sunny, cloudy, and windy) to the students, he found some GIFs and inserted them in the PPT. In the class, he clicked the GIF, the GIF flipped and the corresponding word turned up. "It works even for illiterate people", said teacher C (M) proudly.

For English lessons, teachers use cutting apps (e.g. MP3 Cutting Master, Quick Cutting, etc.), a dubbing app called Qupeiyin[5], a website called Tianxue[6] and the E Listening and Speaking application for English learning. Qupeiyin app improves students' oral English., and the Tianxue website helps students memorize English words. For example, teacher B (F) added new English words into Tianxue, then opened the website on the seewo whiteboard. Tianxue prepared intriguing exercises, such as multiple choices and matching exercises. E Listening and Speaking application is an innovative English learning product customized for middle school, with the functions of "listening, speaking, reading and writing" based on voice recognition. It provides listening and speaking man-machine dialogue evaluation and essay correction for students which aims to improve students' English listening and speaking performance. It is noted that all apps can be downloaded to the seewo whiteboard. Teacher B (F) identified the suitability of the apps for teaching purposes, and facilitated students' participation.

To support students' critical thinking, creativity, and curiosity, teachers at the school use the seewo whiteboard in several ways (Examples can be found above and in the students' section). Teachers A (F) and C (M) use the *Filling the blanks* method. The blanks stimulate the students' imaginations and prompts them to use their minds to search for a solution. For example, teacher A (F) always draws the mind map of the lesson on the seewo whiteboard. At the beginning of the next lesson, she redraws the mind map of the previous lesson leaving some parts blank. She invites students to fill

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[5] Qupeiyin app provides various short videos for learners to choose, and learners learn English by dubbing the videos. More information can be retrieved from its website: https://www.qupeiyin.cn/.

[6] Tianxue website only serves English teaching at the middle school level. More information can be retrieved from its website: https://www.up366.com/.

the blanks by dragging a block from the answer blocks. Occasionally she will invite one student to draw the mind map on the whiteboard, while the rest of the students draw it on paper. The combination of *Filling the blanks* and *mind map drawing* gives students a comprehensive picture of what is being taught. The mind map-drawing process facilitates students' creativity and curiosity. In a similar vein, teacher C (M) will often leave some blanks in an English article, and ask students to guess which word should be filled in the blank. While choosing the best word for the blank, students need to think critically and evaluate words.

The teachers found that using the seewo whiteboard has several advantages and disadvantages. First, it allows students to open their minds and understand knowledge by visualizing the complex process. Although teacher C (M) is an English teacher, he shared his experience of a geography class he attended two days before the interview. That geography lesson was about the change of day and night on Earth. He said that on the seewo whiteboard he saw how the rotating Earth results in day and night, and how the direction of rotation causes the Sun to rise in the east and set in the west. This was not possible when he was a student decades ago when the teacher used a bulb as the Sun and a ping-pong ball as the Earth. Second, new technologies are easy for teachers and students to use. Third, the class is more active, not only do these technologies have game sections but they also allow students to make presentations in front of the whole class. However there are complaints from teachers about effective time allocation. As some teachers find using technology time consuming hence not enough time for exercises, while others would add more exercises on the screen to better utilize the time. Hence some students might find the teaching pace too fast to keep up, and feel pressurized. It is interesting to use technology in class, but it is uncertain if students have mastered the knowledge. Teacher B (F) said that she regarded technology as an adjustor of the classroom atmosphere. Another shortcoming of using technology is that it relies heavily on the external environment, for example, electricity, Wi-Fi speed, etc. Teacher C (M) shared a story of another teacher's lesson, where the teacher was about to deliver a lesson using new technology and equipment when the electricity went off, he had no choice but to go back to the traditional blackboard to deliver the lesson.

Inclusive learning experiences

Inclusivity is important to the teachers at Xitian Gezhuang Middle School in Miyun District. All teachers (both male and female) are aware that students have varying learning abilities, so they prepare questions with different levels of difficulty. The teacher will show the questions on the PPT and, according to the difficulty level of that question, he/she will ask an appropriate student to answer the question. Teachers can also set competitive mode on the seewo whiteboard, teachers differentiate levels in advance and invite students to complete them. This requires teachers to know their students and spark learning interest for students with learning difficulties.

If students find a class, e.g. English class, difficult to follow, they can continue learning English at home. Teacher C (M) created a WeChat official account called *to be positive and have high aspirations*. This account contains basic information about the school, disseminates news, and has released English learning materials in recent years. Students go home and use their parents' phones to study English through listening and reading. This helps some children to catch up.

Some students in the class have myopia. The seewo whiteboard has a magnifier function, which enables the teacher to magnify the words on the whiteboard. When he/she puts the (virtual) magnifier on a word, it becomes extremely large which is more convenient than using a PPT without the whiteboard where the teacher needs to close the PPT, change the font size of the word and open the PPT again. For the few students who are unable to look at the screen for a long time, teachers give them a printed version of the PPT and ask them to borrow a classmate's notes.

Digital literacy

The teachers at Xitian Gezhuang Middle School in Miyun District exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society. Before teachers search for teaching materials online, they design the teaching activities. Based on the designed teaching activities, content is obtained from the Xueke[7] website or the National Public Service Platform for Educational Resources (This platform is a central government innovation to provide basic public services for education; more information is available at: https://www.eduyun.cn/), edited to make it suitable and then used in class. Teacher A (F) teaches Morality and the Rule of Law. She always refers to information from the Xuexi Qiangguo website/app (This website or app is supervised by the Publicity Department of the CPC Central Committee. It focuses on Xi Jinping's Thoughts on Socialism with Chinese Characteristics for a New Era and the spirit of the 19th National Congress of the CPC. It is a high-quality platform for all Party members and the whole of society. More information is available at: https://www.xuexi.cn/) and WeChat official accounts such as *Morality and Rule of Law at the middle school level*. If she finds suitable content, she downloads them into her laptop and links them to the seewo whiteboard. For English teaching, teacher B (F) obtains reading materials from the Tianxue website, selecting easy ones for students since they do not have a solid foundation. Teacher C (M) gets inspiration from the students. He finds that the Himalaya app has a wealth of   high quality audio English listening materials which he downloads and uses for English teaching.

Furthermore, teachers at Xitian Gezhuang Middle School in Miyun District collect student data to modify their teaching. In exams, students answer questions on the answer sheet which are collected and scanned, then the data processed on a platform where a diagnostic report is produced for the teachers. If most students have

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[7] Xueke website provides quality educational resources for the primary and middle level, including examination papers, PPTs, teaching plans. More information is available at: https://www.zxxk.com/.

difficulties with some particular knowledge points, teachers will explain them again and for upcoming similar knowledge points, teachers will spend more time on those and add more practice time.

Professional growth

The teachers at Xitian Gezhuang Middle School in Miyun District continue to improve their professional practice in their school and professional community by promoting and demonstrating the effective use of the seewo whiteboard. To illustrate, they actively explore and discuss the usage of seewo whiteboards in their teaching with colleagues. There are many interesting activities for different subjects available to use with the seewo whiteboard, however some teachers don't know where to find or how to use the relevant template. Young teachers often get together and discuss how to integrate new technology in class and then share their thoughts and ideas with others who are not so familiar or proficient with technology. In addition, teachers at the school listen to each other's lessons and provide advice on teaching and creative applications of technology. For example, teacher B (F) shared her story. She listened to a lesson on world geography and informed the geography teacher that the seewo whiteboard has related resources, such as an Earth model with a 3D view.

Under the guidance of the 14th Five-Year Plan (2021-2025), Xitian Gezhuang Middle School in Miyun District stresses educational informationization. Educational informationization has two meanings: one is to bring the improvement of information literacy into the educational goal and cultivate talents adapted to the information society; the second is to effectively integrate information technology into teaching management and scientific research, pay attention to the development, and utilization of educational information resources. The core of educational informationization is teaching informatization, which is to make teaching methods more scientific and technological, dissemination of education information, and teaching mode modernization.

Teachers have the opportunity to attend the training program delivered by a leader from the education commission information center in Miyun District. To further develop teachers' capabilities in teaching and technology applications, the school has built a partnership with Beijing National Day School (see http://www.bnds.cn/) to create a "Double Teacher Classroom"[8]. For the rural students in Miyun District, there are two teachers in one classroom - one is the rural teacher physically in the classroom with them, the other is the urban teacher online from a distance. In class, the teachers and students at Xitian Gezhuang Middle School in Miyun District watch the classes delivered at Beijing National Day School in real-time, online, on the seewo whiteboard. The rural teachers not only learn teaching tactics from the urban teachers but also how to apply technology in teaching. After the distance learning, the rural teachers give further explanation to the rural students. The

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[8] "Double Teacher Classroom" teaching mode helps the rural schools get out of the dilemma and makes up for the shortcomings of educational resources.

"Double Teacher Classroom" mode improves the educational quality in rural areas to a certain extent and brings quality teachers into the rural classrooms in real-time.

Students

Technology operations and concepts

Generally, the students at Xitian Gezhuang Middle School in Miyun District demonstrated a basic understanding of technology in their learning experiences. They were proficient with Microsoft office software and their frequent use of the seewo whiteboard to display worksheets, quizzes, and tests showed that they were comfortable in its use in the classroom. The students interviewed (three girls and two boys) felt that they were very familiar with PowerPoint and Word since they have plenty of opportunities to use this software on the seewo whiteboard in class, and they felt that the amount of time allowed for the use of this software was sufficient. The interviewed students also mentioned an application called E Listening and Speaking for English learning. They practice English using the E Listening and Speaking application on the seewo whiteboard, and are also encouraged by their English teachers to use this app after class.

Creative and Critical Learning through technology

The students at Xitian Gezhuang Middle School in Miyun District felt that technology usage at school was relevant to their study and life. Although they had limited access to technology tools, and the use of the current software like PowerPoint and Word was to some extent underdeveloped and mono-functioned, students still held very positive attitudes towards the use of technology tools in their daily life. Students believed that PowerPoint is an easy program to use and a powerful tool for giving presentations and consider it as a crucial skill in their future work and life. For instance, their English teacher would use the seewo whiteboard to display quizzes and tests, give 5-10 minutes for students to do the exercise, and use PowerPoint slides to help students check answers. The interviewed students stated that the game function, for example the matching exercise and competition mode, on the seewo whiteboard provided creative scenes for students to apply knowledge, which further facilitated their creative mind and critical learning. In addition, additional knowledge on the PPT expands on the knowledge in the textbook so that students learn critically rather than just accepting the information from the textbook.

Communication and collaboration

Technology tools enabled students to work collaboratively with their classmates. For instance, one of the interviewed students mentioned a group project which they performed during their Chinese class. The seewo whiteboard has a function called random group division where, after the teacher clicked the random group button, students were assigned into small groups and learned different story structures as a group. One of the most common story structures is the three-act structure, which divides a story into three parts, representing the beginning, middle, and end. The

assigned small groups would need to identify the overall pattern and framework of the story and draw a mind map to get all their ideas in one place. Students were asked to display their mind map on the seewo whiteboard by using PowerPoint and explain their thoughts and ideas one by one as a group. During the process, students may need to break complex tasks into parts and steps, plan and manage time with their group members, and refine their understanding of different story structures through discussion and explanation. After their presentation, teachers and other groups of students would give further comments and feedback on the performance. The interviewed students stated that by interacting with the seewo whiteboard they have developed stronger communication skills through this project.

Impact on learning

Generally, the students at Xitian Gezhuang Middle School in Miyun District reported that technology has a positive impact on their learning experiences. They believed that the technology used at school is beneficial for their future work and life, therefore they were willing to devote more time and effort to using technology in their study and would love to spend more time exploring technology tools to assist their learning. The interviewed students reported that they found their group projects on identifying story structures very interesting and attractive because they gained a sense of confidence to tackle more complex problems than they could on their own. The use of the seewo whiteboard made the class interactive and provided them more opportunities to stand in front of the class to share the group result, do exercises and even watch "Double Teacher Classroom" online. The use of PowerPoint during their presentation was also regarded as an effective and innovative way for them to share diverse perspectives and develop new approaches to resolving differences.

Since students were proficient with Microsoft office software and the seewo whiteboard, they reported no difficulties and challenges when using these tools. All of them stated that they haven't encountered any major problems, but they admitted that there are a few functions of the tools that were beyond their ability, for example making hyperlinks in the PPT, and they knew that they still needed to improve their ability and skills in this area, and wished to have more exposure and opportunities to learn more.

Factors and Conditions for Success

Technology

Hardware/ software/ infrastructure

To successfully integrate seewo whiteboards in class, Xitian Gezhuang Middle School in Miyun District must ensure the hardware, software, and infrastructure environment needed for effective technology integration. The school is equipped with a high-speed Wi-Fi connection. There are 18 seewo whiteboards, one per classroom. Each teacher has a laptop, and according to teacher Z (M), there are 200-300 laptops and computers in the school which were procured in 2015. The hardware is not new,

some seewo whiteboard screens are no longer clear, but most of them are workable. All hardware is equipped with the necessary software which was selected by its suitability for the class. For example, the seewo whiteboard makes the interactive class possible.

Teacher Z (M) also mentioned some unsuitable hardware, software, and infrastructure at the school to illustrate the exploration process. The school tried projectors in class, but they aged quickly. Projectors remain new and have high sensitivity in the first year, but they started to have all kinds of mechanical problems from the second year on. The projector is not cost-effective since it incurs long-term maintenance costs, for example the projector bulb needs to be changed regularly. The school purchased a virtual physics laboratory and a virtual chemistry laboratory for its information center. The virtual labs enable students to carry out dangerous experiments in a virtual environment. However, the compatibility issue between the school's Windows software and the lab software made the lab software difficult to use. The school bought some accounts from the Beijing Education Resources website. It was convenient at first but as the website was updated slowly, the content on the website became outdated, so it was no longer suitable. The school also bought some software called *PPT Master* for teachers to make PPTs more easily. It was later found that the software only worked on the licensed computer and not generally, so it was abandoned because of this shortcoming.

Costs and financing

There are various costs required for technology integration in the school, including Wi-Fi connection, maintenance cost, electricity cost, and the above-mentioned costs for hardware, software, and infrastructure.

The *Miyun District Education Commission* financed all relevant costs. It implements the policies, decisions and arrangements of the CPC Central Committee on education and the Beijing Municipal Education Commission, and adheres to and strengthens the centralized and unified leadership of the Party on education in the process of performing its duties.

If the funds from *Beijing Municipal Education Commission* are not enough for technology integration, the school will adjust its plan to suit the available funds. As teacher Z (M) puts it, "if we don't have sufficient funds, we won't buy high-end equipment".

Maintenance

The information center of Xitian Gezhuang Middle School in Miyun District is in charge of setting up, keeping up, and maintaining the hardware, software, and infrastructure needed at the school. Since teacher Z (M) is the IT manager of the information center, he is basically responsible for maintenance affairs. He setup a

WeChat group to deal with maintenance issues and invited all teachers and tech people from commercial companies into the group. When teachers have tech problems, they would send a fix request to teacher Z (M). He can handle the tech problems in most cases, but if he is unable to fix them he will then contact the tech people from the appropriate company. Teacher Z (M) likes computers and new technologies and is also good at fixing tech problems. One difficulty he faces is, because of his health issues he finds it difficult to climb high to fix equipment on a daily basis. Another challenge is financial support. Generally, if the hardware is good, he can always fix the problem, however, if the hardware is broken, he needs to apply to the school for funds. Teacher Z (M) is the IT manager of the information center and has no teaching duty. If he thinks it necessary to buy new hardware, he reports to the head of the information center who will ask for permission from the vice principal who oversees IT affairs.

Security

Xitian Gezhuang Middle School in Miyun District addresses physical and data security in several ways. The physical equipment is stored in the classroom, and the door is locked. For data security, the school has multiple interventions. The school uses the education commission intranet which blocks unsafe data including computer viruses. The teachers install anti-virus software like *360 Safeguard*. Overall, the internet environment at the school is quite safe. Teacher Z (M) uses the school's WeChat official account to post some tips on cybersecurity, email safety, etc. He informs the teachers to use *360 Safeguard* to remove viruses, empty the computer cache, and not be curious about unknown links and advertisements. If teachers do encounter a data safety issue, teacher Z (M) monitors and fixes it through an internet protocol.

The school considers and addresses the diverse needs and circumstances of students. Regulations regarding the usage of classrooms, technology management, etc. are displayed on school walls. The school is caring towards everyone, teacher Z (M) shared a story about a child with generalized dystonia. The parents were allowed to accompany the child, and the school provided free meals for them. During distance learning, the school provided the child with a laptop to encourage him to continue being strong. Other students do not have free laptops. The school organized a learning group in the child's community, encouraging other students to help the child with studying.

School

Governance and Regulations

In terms of technology integration, the school mainly adopted and integrated the national documentation and regulations into their school's work. During the interview, the dean of studies expressed that they have attached great importance to ICT

integration in their daily teaching.Since the integration of ICT is specified, clearly defined and demanded in the national documents and regulations, the school governance takes technology integration as an important issue, so that it serves a purpose and leads toward agreed outcomes for teachers and students. The dean of studies expressed that the decision-making process that leads to the introduction of any kind of new technology into the school is very cautious. The school principal would organize a panel of experts which includes school teachers and the dean of studies and at times they would invite professors from the faculty of educational technology of Beijing Normal University to join the panel. The panel first needs to do research and investigation towards targeted products and technology, possibly carry out trials at school, and ask for feedback and comments from teachers and students. Once the panel decided that they want to bring in this new technology, they would still need to request special funds from Miyun District Education Commission who will assess their application and decide whether to allocate the appropriation. The entire process would be time-consuming, and basically, all the stakeholders including school principals, school management, deans of studies, and frontline teachers need to take part in the decision making process. However, the school doesn't have much influence over the decision of Miyun District Education Commission and funds approval cannot be guaranteed.

Capacity development

Xitian Gezhuang Middle School in Miyun District prepares and supports its staff and teachers for new technology integration through training programs provided by the Miyun District Education Commission. Due to the promotion of the Education Informatization 2.0 Action Plan, MOE (2018) stressed the importance of "digital competence" and "media and information literacy" of instructors, so the education commission in many districts has provided several training programs for the integration of ICT in schools. The main features of the training program involve innovation-driven development rather than technology-driven development, committing to the expansion of digital educational resources rather than the digital presentation of textbooks, and aiming at improving teachers' and students' information literacy rather than the applied skills of information technology. Xitian Gezhuang Middle School in Miyun District has been taking this training program for almost one year, and is now approaching the final part. The training program mainly provides online courses for teachers and school leaders, most of the courses are very practical and target the problems and issues which educators might encounter in the classroom. The dean of studies reported that teachers had very positive feedback towards this training program, and did see some improvement in their teaching methods and strategies. For example, one of the interviewed teachers reported that she was not familiar with the various functions of seewoo products at first. She felt that these new technologies were more like a liability to her, she had to constantly remind herself to use these functions, and it actually interrupted her original teaching progress and habits. However, her attitude towards seewo has shifted and changed after she completed the training programs, she felt more comfortable with using the various

functions during class to assist her teaching, and she found the magnifying lens function quite helpful.

Besides the training programs provided by Miyun District, the panel would also organize and invite experts from universities and tech companies to conduct workshops on using seewo whiteboards, and the school has the training budget to cover the expenses and experts' fees. The dean of studies reported that, by the completion of training, she noticed that many teachers have adjusted their teaching methods and switched from using the blackboards to using the seewo whiteboards during class. Teachers became more familiar with the functions of *seewo* and the frequency of using *seewo* has also increased in all subjects.

Learning Culture

Xitian Gezhuang Middle School in Miyun District has implemented many teaching and learning-related activities among teachers. Although they don't have regular training programs towards ICT integration, they do have many activities and programs which combined numerous elements. The deans of studies would regularly hold joint research in teaching, evaluation of backbone teachers, and competitions for young teachers. During teachers' evaluation and teaching competitions, their ability to use ICT for formative learning assessments, individualized instruction, accessing online resources, and fostering student interaction and collaboration were assessed and evaluated. Feedback and comments would be given to teachers during this process, and specific guidance on ICT teaching and learning within each discipline would also be given to teachers. The school also has evaluation requirements for teachers to acquire the basic ICT literacy skills, ICT use in pedagogical settings, and discipline-specific uses.

External partnership and support

The expenditures on technology equipment of the school heavily rely on the annual government budget on education, both from the municipal and district governments. Currently, there is no external support or resource to maintain and grow the technology environment at the school, however the school supports its teachers and students to access external information and community resources to enhance their teaching and learning. For example, the E Listening and Speaking application is promoted and provided by the Miyun District Education Commission, students and teachers can use the app for free. It features mock tests tailored by local examination outlines and accurate scoring supported by official scoring technologies.

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School Case Study Report-The Fourth Primary School in Miyun District

School name	The Fourth Primary School in Miyun District	
Local researcher	Baoping Li/ Weng Xin/Yifan Lu	
Researcher contact details	Email: luyf@inruled.org	Telephone: +86(18519522768)
Interviewees	**Type of interviewee**	**Information**
	School leadership	Teacher X (F), leader of Math educational research group Teacher Y (M), leader of Chinese educational research group
	Technology coordinator	Teacher Z (F), Director of the Information and Technology Center
	Teachers	Number of teachers interviewed: 4 Subjects taught: Teacher A (F): Legal Education; Teacher B (F): Chinese; Teacher C (F): Math; Teacher E (M): Information Technology Years of teaching: Teacher A (F): 16 years; Teacher B (F): 16 years; Teacher C (F): 12 years; Teacher E (M): 8 years
	Students	Number of students interviewed: 7 students Grades/Years of the students: Student A: 6th Grade(M) Student B: 6th Grade(M) Student C: 6th Grade(F) Student D: 6th Grade(F) Student E: 6th Grade(F) Student F: 5th Grade (F) Student G: 5th Grade(M)

General Information about the School

Address of the school	Miyun District, Beijing, China
Contact information	N/A
Basic information about the school	
Public or Private?	Public
When was the school established?	1996
Vision of the school	The school motto is: Unity, Diligence, be Realistic and Enterprising
Number of students (Female/Male)	982（461/521）
Number of teachers (Female/Male)	73(61/12)
How many non-teaching staff? (F/M)	/
Average class size	42
Community context of the school	
Geography	The Fourth Primary School is in Miyun District. The district is situated in the northeast of Beijing, the capital of China, covering a total area of 2,229.45 square kilometres (Beijing's largest district). It has 2 sub-districts, 17 towns and 1 village (regional office) with the district government seat located in Gulou Subdistrict.

As the easternmost point of Beijing Municipality, Miyun borders Hebei province to the north and east as well as the Beijing districts of Pinggu to the southeast, Shunyi to the southwest and Huairou to the west. In the centre of the district is the Miyun Reservoir with a maximum water surface area of 188 square kilometres and a maximum storage capacity of 4.375 billion cubic meters, it plays a significant role in supplying drinking water to Beijing. There is also a section of the Great Wall, Simatai, a popular tourist attraction in Miyun District, and the Nanshan Ski Resort, one of the largest in the country.

Being one of China's national ecological zones, the district has 73.63% forest coverage and is world renowned for its recreation and suitability for living. The number of days when the air quality is of or better than Grade II has remained above 80% for four consecutive years. The negative oxygen ion content in the air is 40 times higher than that in the urban area, the ecological quality ranking No.1 of the whole city. |
| People/ demographics | At the end of 2020, the permanent population of Miyun District was 528,000. Male residents (270,000) outnumbered female (258,000). The figure for age group 0-14 years is 67,000, representing 12.7% of the whole population in the district (Miyun District People's Government of Beijing Municipality, 2021). Miyun District is Beijing's famous "Home of the Longevity", with more than 600 elders over 90 years old.

As of 2020, Miyun District citizens earned an annual per capita income |

	of 39,282 yuan and annual per capita expenditure was 24,262 yuan (Miyun District People's Government of Beijing Municipality, 2021).
Economy and industry	According to preliminary calculation, the district's GDP reached CNY 33.86 billion in 2020. Industry, construction, and real-estate sectors respectively contributed 15%, 10.2% and 22% of the total GDP. The remaining sectors all contributed less than 10% of the total GDP (Miyun District People's Government of Beijing Municipality, 2021). The Fourth Primary School in Miyun District is located near the Miyun Economic Development Zone Management Committee, which take responsibility for the management and coordination of this state-level economic and technological development zone. The infrastructure in the development zone has fully realized "nine links and one levelling" (nine links refer to water supply, drainage, power supply, communication, transportation, heat supply, gas supply, optical fiber network and cable TV; one levelling refers to the natural levelling of land).

Technology Uses and Impacts

Teachers

Instructions

The teachers at The Fourth Primary School in Miyun District use their knowledge of the subject matter, education, and technology to facilitate experiences that advance student learning in both face-to-face and virtual environments. For example, teachers use *seewo*[9] products to help students better understand the knowledge. Each classroom is equipped with a seewo whiteboard (Figure 1), an EasiCamera (Figure 2), and some feedback devices (Figure 3). Each seewo whiteboard has an app called EasiCare installed. Teachers' smartphones have an app called seewolink installed.
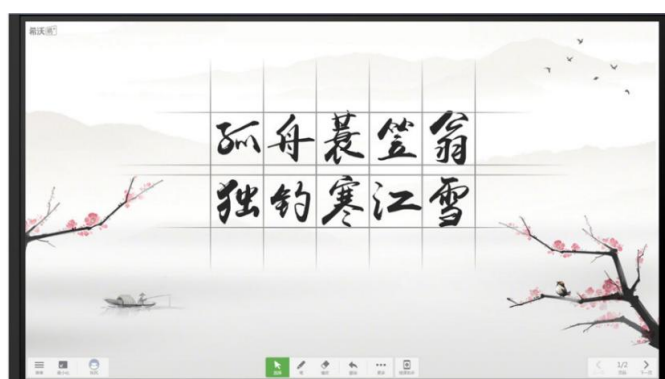

Figure 1: seewo whiteboard

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[9] seewo is a tech company that provides various interactive educational products, such as interactive whiteboards, EasiCamera, feedback devices and related apps. More information can be retrieved from its website: https://www.seewo.com/.

Figure 2: EasiCamera

Figure 3: feedback device

Generally, teachers at The Fourth Primary School in Miyun District use the seewo whiteboard to display their PPTs, videos, etc. The whiteboard enables teachers and students to drag and snap the blocks on the whiteboard, to show the changing process. This function is especially useful for Chinese and Math lessons. For Chinese subject, teachers need to present the vivid view behind the words, for example Chinese ancient poetry. As for Math subject, it has strong logic and demands abstract thinking for questions in relation to space, dynamic process and complex calculation. The EasiCamera can be used by teachers to show the details of objects, however, it can at most only show two objects at one time. Then teachers use the seewolink app to take photos of, for example, students' assignments and upload them to the seewo whiteboard, for everyone to see them clearly. As teacher C (F) said, "We take photos of students' work and ideas with our smartphones and use the seewolink app to upload these photos to the seewo whiteboard, then share them with the whole class". Teacher E (M) also reported that EasiCamera and seewolink were very helpful and enhanced the overall teaching efficiency of his class since he would use this presentation function to display the protocol and steps of operating robots or other devices to the students.

These are the common tools teachers use in class, and they also use feedback devices, a seewo product, and EasiCare to liven up the class. For example, teacher C (F) would use feedback devices to collect data to make bar graphs. She conducted a survey about which fruit students liked the most, to create an authentic scene for the Math class. Data needed was generated by students selecting the fruit option on the feedback device. The exercise made the students excited because the data was generated by themselves. EasiCare, another application on the seewo whiteboard. helps teachers maintain an active classroom atmosphere. The teacher logs into the EasiCare app to give credits to active students in class. For example, students who raise their hands can get one point and if their answers are correct, they get an additional point. Students are interested in the evaluation and value the credits. Teacher B (F) thought that EasiCare facilitated children to have active participation in class.

To support students' critical thinking, creativity, and curiosity, teachers at the school use *seewo* products and robots in several ways. The whole set of seewo products enables teachers and students to interact with each other. Students think on their own and present their ideas with EasiCamera or seewolink. The teacher walks around the classroom, takes photos of students' assignments, then uploads them to the seewo whiteboard through seewolink - an app installed on the teacher's phone. Sometimes the teacher puts assignments or examination papers under the EasiCamera so they can be seen on the seewo whiteboard. There is no great difference between the EasiCamera and seewolink, as they both can transfer the paper content to the seewo whiteboard. By discussing the displayed assignment or examination paper, students present their opinions and the teacher gives comments. Students develop their curiosities and critical thinking. Working with robots stimulates their creativity and curiosity.

The teachers found that using seewo products has several advantages and one disadvantage. All teachers agree that seewo products enable students to visualize the knowledge, which helps them better understand the content in class. For example, teacher B (F) uses the seewo whiteboard to present the vivid scenes behind Chinese poems. Since these seewo products are designed for teaching and learning, they enhance classroom efficiency. For example, take the above fruit survey, teacher C (F) mentioned that without the feedback devices, she needed to initiate a vote and then count the numbers of each category making   it impossible to complete the teaching task. However, with the help of feedback devices, the data was collected in no time, she could finish the teaching task while delivering interesting lessons. The seewo whiteboard and the EasiCamera have some noteworthy functions for making the class interactive. For example, teachers can invite students to do a matching exercise on the seewo whiteboard with students presenting their outcomes on the seewo whiteboard. With EasiCamera, teachers can mark students' assignments and show the marking process. The only disadvantage teachers mentioned is its dependency on a high-speed Wi-Fi connection. Teacher A (F) said, "The seewo whiteboard is useful but it requires a stable Wi-Fi connection. The Wi-Fi connection in our school is very good, but this is

not always the case in some schools, so you need to prepare a PPT and use it when the internet is not good".

Inclusive learning experiences

The teachers at The Fourth Primary School in Miyun District care about the issue of inclusivity. Overall, all teachers agree that seewo products are easy to use and tech operations for students are also easy. However, it is quite difficult for teachers to differentiate content during class, but they would use other kinds of differentiated instruction methods like the use of ongoing assessment and flexible grouping to make a successful approach to instruction. For students who have different strengths and advantages, teachers would use grouping and teamwork to unleash their specialty. For example, when delivering a robot lesson, teacher E (M) first divided the whole class into several small groups using the group division function of the seewo whiteboard. In each group, the student who was good at writing would be the recorder, the student who had strong expression ability would be the speaker, the student who was good at coordination would be the team leader, the student who was good at computers would operate the robot. Different tasks made sure that each student's learning need was met. For those students who had difficulty in studying, teacher E spent extra time tutoring them and also encouraged other students to help them. Since the teachers at The Fourth Primary School in Miyun District have the culture of making micro-lectures, they often send micro-lectures to the WeChat group where students and parents can watch them anytime they want. This has been quite helpful during the pandemic lockdowns.

Digital literacy

Teachers at The Fourth Primary School in Miyun District exhibit knowledge, skills, and work processes representative of innovative professionals in a global and digital society. There are many resources available for the teachers, for example, national educational resources online, Miyun District educational cloud platform (with more than 2000 micro-lectures) which teachers can access and use to prepare lessons. Teacher E(M) also reported that high-quality teaching and learning resources are essential to the Information Technology class, and he would spend a lot of time researching and selecting the right resources for the class. In addition, two teachers (F) shared their experience in finding suitable videos for lessons. Teacher A (F) usually would find among different videos 4 or 5   most suitable ones for the teaching goals. If none of the videos is satisfactory, she would then use apps such as the *cutter* to edit the video.

Teachers at The Fourth Primary School in Miyun District collect student data and modify their teaching accordingly. All teachers at the school adjust teaching based on the students' assignments and reactions in class. If teachers find some knowledge points are difficult for most students, she/he will explain them in class and assign

similar assignments again. If necessary, she/he will record micro-lectures, and send them to students.

Professional growth

Teachers at The Fourth Primary School in Miyun District continue to improve their professional practice in their school and professional community by promoting and demonstrating the effective use of technology. To illustrate, novice teachers have learning opportunities from veteran teachers at the school and from the seewo company. The school has a system called *bringing the old with the new*. The veteran teachers have experience in new technologies and some of them have expertise in one specific area, for example video editing, the usage of the seewo whiteboard etc. Each experienced teacher who has specific expertise has a small club which novice teachers join and learn from the veteran teacher in monthly or more frequent workshops. It is mandatory for teachers at the school to record micro-lectures, for which they need to use the cutting app to edit the video. Teacher B (F) has a video editing club, she often teaches editing techniques to novice teachers. As for training from the seewo company, the product manager comes to the school once a year to provide training on seewo products.

All teachers continually develop their professional capabilities by attending exhibition lessons. Teachers hold exhibition lessons at the end of every semester where other teachers can learn how to integrate technology in class. It is worth noting that the school has a partner school in Wei County in Hebei province, which is not advanced in technology use. They meet face to face or online once a semester to discuss each other's use of technology in delivering lessons. Overall, the Fourth Primary School in Miyun District is demonstrative in the field of educational technology, therefore teachers at the school are sometimes invited to another school to give a lecture on technology integration in class.

Students

Technology operations and concepts

Generally, the students at The Fourth Primary School in Miyun District demonstrated a basic understanding of technology in their learning experiences, and were particularly familiar with the seewo products. They can apply digital tools to gather and use information to help their learning, and they can also use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and working and contribute to the learning of others. They were proficient with Microsoft office software and they knew how to navigate through the seewo whiteboard and EasiCamera. Three of the interviewed students (two girls and one boy) were also very enthusiastic about their Information Technology course and Robotics Society Club. All the students interviewed (three boys and four girls) felt that they were equipped with sufficient abilities to use technology for their studies and schoolwork, and the amount of time given to them to

use technology was sufficient. Particularly, three of the interviewed students (two girls and one boy) stated that they enjoyed taking the Information Technology courses, and they were familiar with basic programming concepts and skills. They found coding very interesting because they could write some simple code that keeps applications running which gave them a sense of accomplishment and confidence. The students felt that coding is very relevant to their future projects, work, and life, and they considered digital and technology skills were essential to their personal and career development.

Furthermore, the rest of the interviewed students (two girls and two boys) reported that seewo whiteboards and EasiCamera usage at school are also relevant to their future projects and work. For example, Student F stated that the skills of navigating the seewo whiteboard and EasiCamera represented the basic skills and ability of using new technologies. She believed that her future work and projects would require her to have the ability to master and navigate new technologies in a short time. Unlike their teachers,　students were not instructed or trained to use *seewo* products systematically, but they soon grasped the tricks of using *seewo* by observing and practising during the class. Student G also reported that he was super proud of himself when he helped his teacher to solve a technical issue of the *seewoo* whiteboard during class, which made him feel confident and thrilled about technology.

Creative and Critical Learning through technology

The students interviewed also demonstrated creative thinking, knowledge construction, and innovative product development skills when taking the Information Technology course. For instance, the interviewed students talked about their project of designing circuit robots during their Information Technology class. They could get started making real robots by learning the basics of programming, engineering, and electrical systems. The challenge of this particular circuit project is to get the two eyes of the robot to light up. Students were assigned into small groups and figured out how to build and connect the circuit so the eyes of the robot could light up. One of the interviewed students reported that each of them first did research by themselves through the Internet and textbooks, and came up with a solution of their own. After coming up with a solution or idea, they communicated with each other and explained their ideas with one another. During this process, they would come up with a more ideal and optimal way to solve the problem. In the end, they would apply this method to the robots and test their ideas to see whether they could light up the eyes of the robot or not. The project-based learning aspect of the class enhanced the students' learning experiences and made them more enjoyable. For example, a girl reported that she was really excited to see the eyes of the robot light up, to be able to achieve that gave her a strong sense of accomplishment and made her believe that she could solve problems　more difficult than this or even someday build a robot by herself.

Their teacher also played an important role during this process,　giving advice and guidance to students who encountered problems and difficulties, and guiding them in the right direction. For example, the teacher would use the seewoo

whiteborad to display the basic rules and principles of how the circuits work, and play short videos regarding different types of robots, such as introductory, intermediate and more advanced robots, to give students a sense of idea of how the robots work, and guide them to find the right solutions.

Figure 1: Students testing the circuit robots

Communication and collaboration

To complete the group project, the students worked collaboratively. They would use the Internet to search for key questions and information concerning circuit robots and electrical systems, as well as the traditional ways of looking up information from their textbook. Students would divide their roles and choose the task that fits their interests and strengths. For instance, some group members were first assigned the task of doing the background research of circuit robots, which involves many aspects and dimensions concerning engineering and electrical systems. Other group members would research, summarize, and analyze various information and knowledge regarding circuits robots and electrical systems. Key points and relevant information would also be displayed on the whiteboard for students to think and connect the dots.

The group would organize discussions to share information between them. Each group member would explain their ideas and insights, and receive feedback and comments from their peers. The interviewed students stated that the communication and collaboration were very helpful, and provided them with an opportunity to comb their thoughts and absorb new ideas and perspectives. Each group would first present their thoughts and ideas to the class, then make PPTs or use the EasiCamera to present and explain their finished work.

After the discussion and presentation, they would apply what they had agreed on to the robot, which required further communication and collaboration since there were eight people and only one robot in a group, a team leader had to be chosen to actually operate the robot. For example, the group leader would provide guidance and instruction to the working group about the project. In this case a girl demonstrated her ability and capability during the discussion, showed strong skills in appreciating people's differences, and tried to keep everyone fully engaged in the team project.

Hence she was chosen as a team leader，also in charge of delegating work, overseeing progress towards goals, and coaching team members as needed.

Impact on learning

Generally, the students at The Fourth Primary School in Miyun District reported that technology has a positive impact on their learning experiences. The students expressed that they have obtained academic progression and enjoyment during their learning at school. All the interviewed students reported that they enjoyed project-based learning, and they gained a strong sense of achievement which increased their self-confidence during the problem solving process, and they would continue to explore the challenges of robot evolution and maybe AI in the future.

When asked about the challenges and difficulties they encountered, one girl talked about her experience of identifying problems and tackling them. She said she could use the computer and other technology tools to complete some basic operations, such as checking emails, searching for information on the Internet, and basic coding and programming, however she also met difficulties and challenges when approaching new technology tools. She was encouraged by her parents to integrate some basic skills into her daily life, starting with something simple, like taking videos and pictures during hiking, and then working her way up to getting all of her pictures, videos, notes, and information organized in one place to form a digital diary. She also mentioned another way of improving her digital skills, was to teach digital skills to others, like her friends, and grandparents. She mentioned that it was a great way to maintain her skills and gain a deeper understanding of what she knows.

Factors and Conditions for Success

Technology

Hardware/ software/ infrastructure

To successfully integrate seewo products in class, The Fourth Primary School in Miyun District must ensure the hardware, software, and infrastructure environment needed for effective technology integration. The school is equipped with a high-speed Wi-Fi connection. There are 24 classrooms with seewo products. Each classroom has a seewo whiteboard, an EasiCamera, and some feedback devices. Each seewo whiteboard has the EasiCare app installed. The school has also introduced smart classrooms, four sets of iPads, *seewoo* whiteboards, etc. The director of the Information and Technology Center expressed that the introduction of the hardware and equipment were all based on teachers' concrete needs and demands, and had gone through several rounds of consultations among teachers and staff before the final decisions were made.

Costs and financing

There are various costs required in technology integration in the school,

including Wi-Fi connection, maintenance cost, electricity cost, etc.

Maintenance cost: 10-20 thousand yuan per year

Hardware and software cost:

    4.13 million yuan in 2016;

    0.8 million yuan in 2018;

    1 million yuan in 2020;

    (Note that seewo also provided some free seewo pads.)

The financing arrangements to pay for these costs are mainly from the financial support of the *Miyun District Education Commission*, donations from the seewo company (the school acts as the pilot project for seewo), and the school itself.

The *Miyun District Education Commission* is a government body. It implements the policies, decisions and arrangements of the CPC Central Committee on education and the Beijing Municipal Education Commission, and adheres to and strengthens the centralized and unified leadership of the Party on education in the process of performing its duties.

There are some challenges and difficulties that the school faces in securing the funds required for technology integration. For example, the municipality and district governments don't necessarily approve the budget amount. The funds given are usually lower than required. Teacher Z (F), the school's technology coordinator is active and seizes every opportunity to apply for project funds from the Miyun government. The project financing is not only for the hardware and software cost, but also for research purposes.

Maintenance

Teacher Z (F), the technology coordinator of The Fourth Primary School in Miyun District is in charge of setting up, keeping up, and maintaining the hardware, software, and infrastructure used at the school. If the maintenance workload is heavy, the technology coordinator will request seewo to conduct the maintenance work. If the seewo products are too old to use, the technology coordinator will send them back to seewo. She is a full-time employee of the school and has a regular duty teaching the Information Technology course.

The school has put in place a protocol to ensure defective hardware, software, and infrastructure are reported promptly. When teachers find problems with the technology, they contact the technology coordinator, who will either fix them or contact the tech person from seewo.

Security

The Fourth Primary School in Miyun District addresses physical and data

security in several ways. The physical equipment is stored in the classroom, and the door is locked. Teachers and students have their own seewo accounts and passwords, which provides a certain level of data security. The overall data security is managed by the Miyun District Information Center, so the school itself   has little related work in this matter.

In implementing technology, the school considers and addresses the diverse needs and circumstances of students. At the school level, teachers record micro-lectures to explain difficult teaching points, and then send them to the WeChat group where students can continue learning at home.

School

Governance and Regulations

The governance at The Fourth Primary School in Miyun District played crucial roles in successfully implementing the Information Technology course and the school's overall technology integration. The school has always considered ICT integration as a focal point of their work and has actively promoted and deployed ICT for quality education since 2016. The school believes that ICT can empower teachers and learners, promote change and foster the development of 21st-century skills.

The Fourth Primary School in Miyun District was listed in the "Double Hundred Programs" initiative and was also appraised and elected as the ICT Integration and Innovation Demonstration School by Beijing Municipal Education Commission. The implementation of the "Double Hundred Programs" initiative by the Beijing Municipal Education Commission was designed to fully leverage the exemplary and leading role of the construction and application of experimental teaching courses, promote student-oriented teaching concepts, and explore in-depth integration between advanced technologies and curricular activities. A total of 68 courses, including two from the Fourth Primary School in Miyun District were selected as fine and innovative experimental teaching programs in the initiative. When interviewed, the director of the school's Information and Technology Center stated that the school had already reached the second stage of ICT integration, which targeted ICT incorporation for teaching and learning improvement and integrating ICT into the curriculum.

The school provided regulations that support the successful integration of technology in teaching and learning, as evidenced through the establishment of the Information and Technology Center. At The Fourth Primary School in Miyun District, the leadership was distributed. The school principal fully supports the ICT development and integration of the school and encourages the integration of ICT into the curriculum. The school is also exploring an integrated approach with ICT that creates learning experiences that call on more than one discipline or subject such as cross-discipline assignments or units, project-based learning experiences, curriculum developed across several disciplines, and/or curriculum tied together with overarching themes and questions.

Capacity development

The Fourth Primary School in Miyun District provides consistent support for their teachers through continual professional development regarding ICT integration. According to the academic and teaching leader, the school administration has developed a school-based curriculum that focuses on the mentoring of novice teachers. While teacher-mentors and novice educator-mentees are the focus of the school's mentoring program, administrators definitely played a dynamic role regarding the tone and implementation. For example, the principal who is in charge of the training program invited the entire staff to provide supplementary guidance for novice teachers or even met monthly to hear their concerns and provide personal feedback. Well-trained mentors are the foundation of a successful mentoring program, so the school administration carefully selected expert teachers who wanted to take on a mentoring role and agreed to participate in specialized training. This expert mentoring could assist novice teachers to build their teaching capabilities and the necessary digital skills required during class more quickly and also lay the foundation for innovative professional practice. As for experienced teachers, the mentor would foster the novice teacher's learning and attend to his/her needs. The program provides the mentees with opportunities to co-teach lessons, collaboratively plan, visit and observe expert teachers and their classrooms followed by an in-depth mentor-guided reflection on takeaway understanding. The novice teachers require extensive, ongoing exposure to ICT to be able to evaluate and select the most appropriate resources, which is also the purpose of this school-based curriculum.

In the past five years, the school's Information and Technology Center has provided continual professional development courses on new technologies such as the *seewo* whiteboard, EasiCamera, educational technology for classroom interaction, gamification, learning management system, and intro to robotics. The teachers and staff found these courses particularly useful, for example, the introduction to robotics was crucial for IT teachers. The school has established a support system of teachers who are experienced in teaching with robotics, who have built an online community, which is a great place to share robotics lesson plans, ask questions, and seek advice. Since the seewoo whiteboard is also considered the most traditional, fundamental technology, and is associated with whole-class instruction, the school's Information and Technology Center has also provided related training and courses regarding the basic skills of interactive white boards.

Learning Culture

The Fourth Primary School in Miyun District actively works to nurture and promote a strong learning culture where new technologies are infused. To build a learning culture and atmosphere for teachers to immerse themselves in, the school has introduced the mentoring program to help and support novice teachers. Mentoring is considered as a set of structured assistance and support activities in the process of ICT integration and teachers' ability building process. It is designed to answer novice teachers' questions, provide emotional support and fill in the gaps left by the Information and Technology Center's training programs. The program consists of a

comprehensive, coherent, and sustained professional development program to train, support and ultimately retain novice teachers. It can also scaffold novice teachers to a lifelong learning track. Although principals technically are not mentors, they play a key role in the mentoring process. They are responsible for designing and administering the mentoring process, and novice teachers look to their principals for feedback, guidance and support. As mentioned before, the principal who is in charge of the training program met monthly to hear teachers' concerns and provide personal feedback to them.

The mentoring process doesn't just benefit novice teachers. While it provides novice teachers access to veteran teacher's expertise and wisdom, mentoring also gives the experienced teachers a way to validate their expertise and to pass on the benefits of their experience to a new generation of teachers, benefiting both mentors and their charges.

External partnership and support

The school's fund for expenditure on technology equipment comes mainly from the annual government expenditure on education, both from the municipal and district governments. Since the school was listed in the "Double Hundred Programs" initiative and was also appraised and elected as the ICT Integration and Innovation Demonstration School by Beijing Municipal Education Commission, and has demonstrated successful technology integration into the school's instructional and management practices, many technology companies including seewoo have approached them for cooperation and collaboration and offered to craft personalized product for their students. As a school with high teaching quality and a willingness to experiment and try frontier technologies, the school actually provides a great environment for seewoo to test their products, get feedback and suggestions to further improve their products.

School Case Study Report-The Experimental High School Attached to Beijing Normal University (ESBNU)

School name	The Experimental High School Attached To Beijing Normal University (ESBNU)	
Local researcher	Baoping Li/ Weng Xin/Yifan Lu	
Researcher contact details	Email: luyf@inruled.org	Telephone: +86(18519522768)
Interviewees	**Type of interviewee**	**Information**
	School leadership	Vice-principal (M) Director of the Information and Technology Center(M)
	Technology coordinator	Teacher Z (M), IT Coordinator
	Teachers	Number of teachers interviewed: 3 Subjects taught: Teacher A (M): English; Teacher B (M): Math; Teacher C (F): Psychology; Years of teaching: Teacher A (M): 3 years; Teacher B (M): 1 year; Teacher C (F): 5 years;
	Students	Number of students interviewed: 5 students Grades/Years of the students: Student A: 7th Grade(F) Student B: 7th Grade (F) Student C: 8th Grade(M) Student D: 8th Grade(M) Student E: 8th Grade(M)

General Information about the School

Address of the school	Xicheng District, Beijing, China
Contact information	N/A
Basic information about the school	
Public or Private?	Public
When was the school established?	1917
Vision of the school	ESBNU is a key school that has gained considerable fame in China. It is an experimental base for instituting the teaching reforms of the Ministry of Education and Beijing Normal University, as well as a cradle for training outstanding middle school students from all parts of China. The vision of the school is to cultivate strong, all-round talents.
Number of students (Female/Male)	4,551 (2,187 females: 2,364 males)
Number of teachers (Female/Male)	516 (350 females: 166 males)
How many non-teaching staff? (F/M)	/
Average class size	44
Community context of the school	
Geography	ESBNU is in Xicheng District, Beijing, the capital of China. The district houses the offices of the CPC Central Committee, the National People's Congress, The State Council, the National Committee of the Chinese People's Political Consultative Conference (CPPCC) and other party and government bodies. It is a major political and cultural center, an area for foreign exchanges at the highest level and an important window to present China's image to the world. Xicheng District covers an area of 50.7 square kilometers. The 15 sub-districts under the jurisdiction of Xicheng District have permanent populations as follows: >100,000 3 sub-districts 50,000-100,000 7 sub-districts <50,000 5 sub-districts The school is in the neighborhoods of Jinrong sub-district and Xichang'anjie sub-district, with 54,849 and 36,645 permanent population respectively in 2021 (Xicheng District People's Government of Beijing Municipality, 2021). The school is located next to the Ministry of Education, approximately 3.5 kilometers from Tian'anmen Square and 6 kilometers from Beijing Normal University.
People/ demographics	At the end of 2021, Xicheng District had a total of 1,106,214 permanent residents with female residents (569,752) outnumbering male (536,462). The figure for the age group 0-14 years is 157,912, representing 14.3% of the whole

	population in Xicheng District (Xicheng District People's Government of Beijing Municipality, 2021). As of 2020, Xicheng District citizens earned an annual per capita income of 90,286 yuan and annual per capita expenditure was 51,466 yuan (Xicheng District People's Government of Beijing Municipality, 2021). The Engel's Coefficient was 19.7%, showing local people were wealthy.
Economy and industry	In 2020, the GDP of Xicheng District reached 506.11 billion yuan. The financial sector contributed 52.4% of the total GDP. Public administration, social security, and social organizations contributed 5.5% of the total GDP with the remaining sectors contributing less than 5.5% of the total GDP. It showed that the financial sector played a pivotal role in Xicheng District. Xicheng District People's Government is dedicated to improving the quality of life of citizens in the district. The government vigorously promotes the construction of public cultural facilities. Based on two district-level cultural centers and three district-level libraries, Xicheng district has implemented the project of popularizing one cultural station, one community education school, two libraries, and one digital cinema in each street. Overall, education and learning culture are integrated into Xicheng District and technology is a tool to assist the realization of goals.

Technology Uses and Impacts

Teachers

Instructions

The teachers at The Experimental High School Attached To Beijing Normal University (ESBNU) use their knowledge of the subject matter, education, and technology to facilitate experiences that advance student learning in both face-to-face and virtual environments. For example, the teachers implement *blended learning* in practice. They use an online teaching and learning platform - **Classin** (Figure 1) to teach online and use the **smart classroom** (Figure 2) to teach offline.

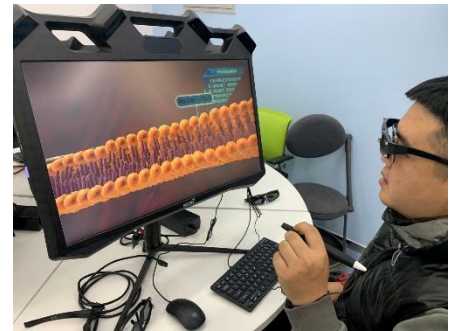Figure 1: Classin online teaching and learning platform
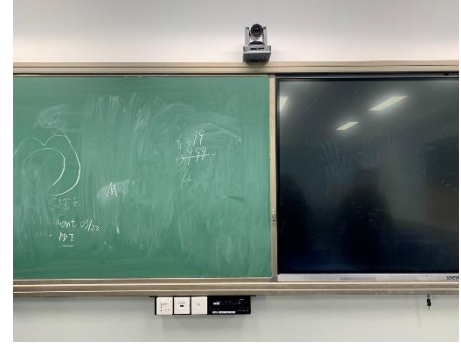
seewo whiteboard

Microphones

VR glasses

Smart Classrooms

Figure 2: Smart Classroom and its internal hardware

The school promoted the Classin platform during the school lockdown and continued to use it as a supplement after the school reopened. Classin creates a virtual classroom while realizing some functions that are thought to be only possible in offline teaching settings. The teachers deliver online lessons on Classin, while students not only watch the lesson but also able to click the raise hand button to ask questions. If students forget to mute, teachers can mute students to control class discipline. After the class, students upload their homework, teachers mark the homework and give feedback to students. There are additional functions, for example, group discussions where teachers can randomly divide students into small groups. The lessons are saved automatically to the platform where students have access to them at anytime. For example, teacher A (M) delivered a writing class to grade 7 students. He

shared his PPT on the virtual blackboard on the Classin platform. The lesson was to write a story based on the photos shown. The students were divided into 5 groups and given 5 minutes to discuss the photos. The platform has a timer tool which teacher A set. When the time was up, he put all students together and randomly selected some students to tell the story and gave them comments. After the class, he asked all students to write an essay and upload it to the Classin platform. There was a portal for students to upload homework and teachers to check and leave comments for students to see. The students can replay the class video whenever necessary.

At ESBNU, there are four distinctive smart classrooms equipped with one seewo interactive whiteboard, two cameras (one in the front and one in the back), some microphones, and a learning corner with a VR experience zone. Teachers in class could use the seewo whiteboard as the main teaching tool to arouse students' enthusiasm for the lesson and facilitate students' participation and if necessary, guide students to enter the VR experience zone to further explore knowledge by themselves. (Concrete example of using the seewo whiteboard and VR experience zone is provided in the next paragraph). The whole class is recorded. The whole smart classroom system makes automatic recording, live broadcasting and lesson storage possible, without interrupting the normal teaching order. After the class, students print their assignments from the *smart-assignment protocol*. Smart-assignment protocol is a platform where teachers upload tailored assignments for each student who, after inputting their student ID and password, can print their assignments. Students scan the finished assignments into the protocol where teachers can correct them online and set the next assignment accordingly.

Teacher B (M) shared his experience of using the smart classroom for a grade 8 Math lesson regarding the links between geometric figures and algebra. A classical math question was about finding multiple solutions without using graphics – the question provided the narrative text without the graphics. This question required students to draw the graphics and explore various possibilities for the solution. The seewo whiteboard made these complex problems into an intuitive and vivid perceptual situation, which made it easier for students to understand and for teachers to explain. Using various tools of the seewo whiteboard, teacher B (M) guided the students by drawing the graphics thereby creating a vivid understanding for the students and showing them his thought process. He also selected students to draw the graphic on the seewo whiteboard to see if they had understood or not. For middle school students, it was difficult at first to imagine the graphics based on the geometric figure however, after viewing the teacher's process and further exploration at the VR experience zone, they understood how to solve similar math questions. After the class, students obtained their individualized assignments. If they were still unclear about the lesson they were able to consolidate their knowledge by reviewing relevant lessons which teachers had earlier uploaded to the Classin platform. All lessons were recorded and uploaded to the Classin platform. Since each class had its own teaching and learning pace, students who did not understand the content in class could watch the recorded video of the class.

To support students' critical thinking, curiosity, and creativity, teachers at the

school used the blended learning model. All teachers are familiar with the tools on the seewo whiteboard or Classin platform to divide students into several groups to facilitate discussions. Students communicate with each other, discuss and put forward evidence for their opinions. Teachers share a piece of student's work and invite other students to point out the pros and cons. Students exercise their critical thinking and curiosity throughout the process. Teachers mentioned exploratory autonomous learning as a way to cultivate creativity. The Classin platform and VR experience zone in the classroom promote students' self-learning. Students can log into the Classin platform and watch lessons which were saved during the pandemic or recorded in the smart classrooms. There is a comprehensive software system covering various subjects in the VR experience zone which the students can use to study on their own. Teachers found that using a blended learning model had several advantages and disadvantages. The whole system of new technologies provided teachers with multiple options for teaching and learning. Teachers could either deliver lessons in the smart classrooms or online with pre-recorded or live broadcast lessons. This ensured students with learning difficulties could review lessons and learn again on their own. Teacher B (M) mentioned that parents were satisfied with the review function. However, all teachers mentioned the cost and pressure of learning this way. When the school closed for lockdown, all teachers were required to use Classin to deliver lessons. The teachers spent a lot of time getting familiar with the Classin platform, especially the functions. The blended learning model had high requirements of teachers' digital literacy and their openness to new technologies. The blended learning model is not mandatory for all teachers at the school, some don't see it as a rigid requirement so they don't record lessons.

Inclusive learning experiences

The teachers at ESBNU care about the issue of inclusivity. There are several ways to ensure inclusivity with the blended learning model enabling students to learn at anytime they want. They can either study on Classin or enrich their learning experience at the VR experience zone. For students with learning difficulties, they can re-watch the lesson and consolidate the knowledge. For example, teacher B (M) teaches three classes – class one, class two, and class three. The teaching pace of class one is faster than classes two and three and the teaching content of class one is more difficult than classes two and three. Therefore, if students in class one have problems understanding the knowledge, they can watch the recorded video of class two or three. Vice versa, if students in classes two and three find lessons easy to follow, they can watch the lessons of class one.

Since there are around 44 students in a class, students at the back have difficulties in seeing the words on the whiteboard. Teachers enlarge the words with the magnifier function. If necessary, teachers print the teaching content in advance and distribute it to students before the class.

Digital literacy

The teachers at ESBNU exhibit knowledge, skills, and work processes representative of innovative professionals in a global and digital society. To help teachers prepare lessons, the school provides accounts on multiple platforms such as the Xueke[10] website and CNKI (China National Knowledge Infrastructure - aims to comprehensively open up information channels in all links of knowledge production, dissemination, diffusion and utilization, and build an exchange and cooperation platform supporting knowledge innovation, learning and application in all industries across China. More information is available at: https://www.cnki.net/). Teachers always bring frontier knowledge to the class, so generally they first search on CNKI to figure out the relevant theories to ensure the knowledge is correct, and to understand the frontier knowledge in the journals. As well as written materials, they also search for some relevant videos and photos online. English teacher A (M) and psychology teacher C (F) made great use of suitable videos and photos downloaded from the internet, often editing the videos.

There are various software options for teaching and learning English. English teacher A (M) used Prezi as well as PPTs. Prezi is a nonlinear, demonstration software that presents knowledge by zooming in and out making it easier for students to learn in comparison to PPTs. When teacher A (M) categorized knowledge he drew a mind map using XMind (XMind is a full-featured mind mapping and brainstorming software designed for inspiration and creativity. More information is available at: https://www.xmind.cn/). Teacher A (M) always arranged homework on the popular dubbing app, Qupeiyin. He required students to find a video with a similar topic to the class, and then imitate the original sound.

Furthermore, teachers at ESBNU used digital data to improve teaching and learning. The blended learning model includes the Classin platform and smart classroom. The lessons delivered in the smart classroom are recorded, uploaded to Classin and saved. The Classin product manager regularly came to the school to share videos with the teachers highlighting potential functions in order to improve their teaching and the students' learning. The system behind the smart assignment also collects the big data of students' assignments, teachers' corrections, and the adjustments of assignment distribution for each student. Based on the diagnostic reports from the system, teachers understand which knowledge points are still confusing to the students, and they then pay more attention to those knowledge points.

Professional growth

Teachers at ESBNU continue to improve their professional practice in their school and professional community by promoting and demonstrating the effective use

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[10] Xueke website provides quality educational resources at the primary and middle level, including examination papers, PPTs, teaching plans. More information can be retrieved from its website: https://www.zxxk.com/.

of technology. To illustrate, they are actively exploring and discussing with colleagues the usage of technology in their instruction. At the school level, the Information and Data Resource Center oversees organizing training activities on technology applications in class, providing fundamental knowledge and basic technology application practice.

At the municipal level, Beijing provides an online website called *teacher club* (Teacher club is a professional institution providing comprehensive learning services for the professional development of primary and secondary school teachers and education administrators in China. It is recognized by the Ministry of Education as "Primary and Secondary School Teacher Training Website", "Distance Network Training Base for Education Cadres", and "Distance Training Institution for Teachers Under the National Training Plan". More information is available at: http://www.teacherclub.com.cn/). According to their needs, teachers select and watch technology integration courses on the website, do the homework and finally acquire credit.

ESBNU is one of the top schools in China, it is also a pioneer in the application of new technology in class. Last November, the school hosted the Space Education Forum online. Academicians, scientists, astronauts, educators and entrepreneurs from the space field at home and abroad gathered to discuss ways to deepen popular science and technology in education. In that forum, teachers at ESBNU used the smart classroom to show how they improve teaching and learning with technology. All participants of the forum discussed the smart classroom, and other schools learned from ESBNU's experience.

Students

Technology operations and concepts

Generally, the students at ESBNU demonstrated a basic understanding of technology in their learning experiences. They were proficient with Microsoft office software and were familiar with Classin, VR and the seewo whiteboard. Students who took the information technology classes or the Robotics and Automation Society Club have expressed a keen interest in programming and have acquired basic scientific knowledge in the fields of robotics and automation, including applied and theoretical issues. The students interviewed (three boys and two girls) felt that they were equipped with sufficient knowledge to navigate the basic technology tools and software to help them with academic learning. The students felt the amount of time allowed on the use of technology was sufficient since most classes were taught in smart classrooms and on Classin. Classin is an online platform that puts live classes, group chats, cloud sharing, and assignments together. Students watch the lesson and, in the assignment module, they see the marked and unfinished assignments. In the marked assignments, they have feedback and get a grade (pass, good or excellent) from the teacher. In the unfinished assignments, students see messages from the teacher, including voice messages, pictures and texts. Students click the hand-in

button where they write the answer and they can also leave pictures and voice messages for the teacher. In the smart classroom, students interact with the teacher using the seewo whiteboard, they often come up to do exercises and present group results on the whiteboard. They also have the freedom to learn subject knowledge in the VR experience zone, where they wear VR glasses and use the pen to explore the 3D world on the computer.

Creative and Critical Learning through technology

The students at ESBNU felt that technology usage at school was relevant to their study and life. For example, they talked about the Classin platform, the seewo whiteboard and VR which they used daily at school. The Classin software is a platform that brings live classes, group chats, cloud sharing, and assignments together. With ample resources, students can access different videos, group chats and materials regarding the same subject content. By evaluating and selecting materials they acquire knowledge through the learning process. In the smart classroom, by watching the teacher presenting the evolving process of a Math calculation, students could feel the magic of Math which in turn stimulates their creativity. Sometimes words can be a major hurdle for students to achieve success in Mathematics. Therefore it is important that teachers attempt to teach Mathematics using the most visual and practical approaches possible. One of these approaches is to employ the philosophy of Visual Literacy, using highly effective images to enable students to interpret more readily and understand the presented mathematical material. When they sit in the VR experience zone, students could also enter the 3D world and explore knowledge by themselves. In education, VR provides an experience foundation for teaching. In the VR experience zone, students are inspired to discover for themselves and have an opportunity to learn by doing rather than just passively reading. By being exposed to various learning resources instead of just reading about things, students could actually see the things they're learning about, and visualizing complex functions or mechanisms makes them easier to comprehend. This self-learning mode forces them to think deeply and critically.

Communication and collaboration

Technology tools enabled students to work collaboratively with their classmates through various forms and channels. For instance, two of the interviewed students mentioned the group division function on Classin and in the smart classroom. The Classin platform provides teachers with a group division function, with a single press of a button students can be randomly divided into different online groups. Although it seems like a simple function, it is quite useful especially for a large number of students. The function also provides teachers with the opportunity of applying the jigsaw method and combines parallel group work (in which each group receives the same assignment) with complementary group work (in which each group receives a different assignment). In the first phase, students are divided into groups (at random), with each group being responsible for a partial assignment. In the second phase, students are re-divided into groups consisting of a representative from each of the

groups from phase one. This essentially resulted in the formation of heterogeneous expert groups. This method allows students to approach a complex assignment from different perspectives, requiring them to compare the various 'pieces of the puzzle', which creates an environment for communication and collaboration.

Some of the interviewed students have a great passion for taking pictures and filming, and they registered for the film appreciation class last semester. During the class they were assigned different tasks and assignments related to taking pictures and shooting micro-films. Most interestingly, they put great effort into comparing the current collaboration software online and selecting the best suitable application for their project. They have also switched software and platform for different projects and tasks since each application has its strengths and weaknesses. Collaborative learning encourages and enables students to work and learn together to study and explore a subject, to solve a problem, to complete a task or an assignment. When it comes to choosing a suitable method and/or tool to support collaborative learning activities, students have already demonstrated the ability of choosing the best technology tools that match the activity, fits their goals and offers the required functionality.

Impact on learning

Generally, the students at ESBNU reported that technology has a positive impact on their learning experiences. The students expressed they have obtained academic progression and enjoyment for learning by using Classin, the seewo whiteboard and the VR experience zone. Students reported that they are motivated by increased class efficiency since teachers no longer need to handwrite everything on the blackboard saving a lot of time for both teachers and students, and the educational productivity has been enhanced.

The Classin platform provides teachers with drawing tools that make teaching Geometry more convenient and efficient in grade 8. Students reported that they felt more interested and attentive when their teachers used the Classin drawing tools since it allows dynamic and interactive manipulations of figures. Students can move, rotate, reflect, or stretch the figure, and observe what properties stay the same. For example, the drawing tools enabled students to draw isosceles triangles which could easily be dragged to make them bigger, smaller, or rotated. Students reported that they could easily see what has or hasn't changed, and they were also offered the opportunities to draw figures and sublines themselves during class. They felt their imagination and creativity had also been increased during the process of drawing and learning. This kind of exploration and hands-on activities can help them to learn the relationships of different shapes.

The Classin platform provides teachers with the function of real-time video recording and playback, and students can access and review the recordings whenever they want. Classin was designed to incorporate cameras so that the entire classroom could be seen, and it also made recording instructional lessons for the benefit of both teachers and students. Some students stated that at times they need to hear information more than once for it to sink in, so being able to watch the recordings, at a slower pace if necessary, as many times as they need helps their understanding. Another

benefit that comes with the recording function is that absent students could catch up with the instruction and flip the classroom.

The students have shown great learning autonomy during their learning process, they could take control and responsibility for their learning, they were capable of self-direction, and were able to develop an independent, proactive approach to their studies. The aforementioned technologies (Classin, seewo whiteboard and VR experience zone) all served as learning aids to enhance students' learning and retention rather than as a substitution for teaching and instruction. Classin enables students to watch lessons multiple times, the seewo whiteboard provides students opportunities to participate in the class, the VR experience zone enables students to learn by themselves. For example, the seewo interactive whiteboards allow projected computer images to be displayed, manipulated, dragged, clicked and copied. Simultaneously, handwritten notes can be taken on the board and saved for later use. Students' engagement is generally higher when the interactive whiteboard is available for students to use throughout the classroom.

However, students also encountered difficulties and challenges when using technology tools. For instance, the interviewed students reported that the function of real-time video recording and playback of ClassIn did not always work fully. If teachers forgot to use Powerpoint in full-screen mode, viewing was difficult and they couldn't see the full content making them miss the points of the class and adversely impacting their learning experience.

Factors and Conditions for Success

Technology

Hardware/ software/ infrastructure

To successfully implement the blended learning model at school, ESBNU must ensure the hardware, software, and infrastructure environment needed for effective technology integration. The school is equipped with a high-speed Wi-Fi connection and 4 smart classrooms. Each smart classroom has a seewo whiteboard, two cameras, several microphones, computers, and VR glasses. Each ordinary classroom is equipped with a seewo whiteboard. All hardware is equipped with the necessary software.

The Information and Technology Center is in charge of educational informatization at the school. It is overseen by a vice-principal and has five main responsibilities:

(1) plan and implement the school's informatization, coordinate matters and optimize processes related to informatization; comprehensively improve the school's informatization management and service level;

(2) arrange the information campus construction and maintenance, for example campus network and infrastructure construction, software and application platform construction, and the operation, management and maintenance of multimedia teaching system;

(3) provide photography, video and live broadcast services for research classes and activities; provide technical support and guarantees for various activities;

(4) sort out, formulate, and maintain related systems for school network information security; provide related training;

(5) provide training for teachers on the school's information technology.

This center unites teaching-related departments to select suitable technologies. In the time of COVID 19, staff in the Center first surveyed the teachers at the school to figure out how they solved teaching problems, and which platform is effective and easy to use. Based on the survey, the staff in the Information and Technology Center evaluated the available educational products provided by the companies. During the lockdown the director (The director is often a veteran teacher who has decades of teaching experience but now no longer teaches and works specifically in the center) of the Information and Technology Center selected Classin amongst some 20 online products. Based on educational theory and practice, four smart classrooms were designed by Beijing Normal University. The key requirement was to facilitate teaching and learning both online and offline. Three of the smart classrooms were used for daily teaching, and were equipped with the necessary technology tools such as ClassIn, projector, and LCD screens. The fourth classroom is equipped with a diversiform of latest technology devices, the likes of touch screen computers, VR glasses, 3D glasses, and 3D computer animation.

Costs and financing

There are various costs required in implementing the blended learning model at the school, including maintenance cost, the Wi-Fi connection, electricity cost, hardware cost, and software cost.

Maintenance cost: 1 million yuan

Hardware and software cost: 20 million yuan

There have been some donations from the companies, but the total amount is limited schoolwide. It is worth noting that most of the equipment in the smart classrooms was donated by the companies. Four smart classrooms were co-built by the school and educational companies including the Classin company, eeo (website: https://www.eeo.cn/cn/), and the seewo company. Overall, the *Xicheng District Education Commission* financed most of the costs needed to implement the blended learning model at the school. The *Xicheng District Education Commission* implements the policies, decisions and arrangements of the CPC Central Committee on education and the Beijing Municipal Education Commission, and adheres to and strengthens the centralized and unified leadership of the Party on education in the process of performing its duties.

Maintenance

Technology maintenance services at ESBNU are mainly provided through the after-sales service of the technology products. The ESBNU Information and Technology Center is responsible for regular and general maintenance. In addition, each class has a multi-media representative, appointed by the headteacher of the class, who has been trained at the center. If teachers have tech problems, they first ask the multi-media representative to solve the problem. If that student cannot fix it, the teacher reports the tech issue in the WeChat maintenance group, a chat group on the *WeChat app*, or directly calls teacher Z (M) from the Center. Teacher Z will come to the classroom within one hour and fix the problem. If the tech problem is too difficult to solve, teacher Z will contact the corresponding company to fix the problem. Teacher Z was an in-service teacher who taught the information technology curriculum. Now he has switched to be a full-time member of the Information and Technology Center without any regular teaching duty, and participates in the implementation of informatization in the school.

Security

ESBNU addresses data security in several ways. First, the school released a document on data safety, especially on data resource sharing. At ESBNU, data is hierarchically authorized with teachers having access to the data of students of their subject, and principals have access to more data. Besides the study data, there are personal data of students, such as parents' information, address, contacts, ethnicity, etc. The school encrypted students' personal information and stored it in the database. For data safety, the school stored all data in the computer lab, ensuring physical and cloud backups. The computer lab has a dual power supply installed.

School

Governance and Regulations

In terms of governance and regulations, ESBNU has established an Information Technology Center which is responsible for the daily operation, management, and maintenance of the school's technology devices and equipment which has the largest number of staff members in the whole school. Regarding the management system, the school has a principal who takes the responsibilities of managing media and technology integration into school teaching and fostering the use of information communication technologies (ICT) at a strategic level and facilitating the ICT integration into school teaching using a diffusion of innovation model. Besides the adoption of education informatization 2.0 in China, the school has also drawn up four documents and regulations regarding ICT integration into teaching concerning computer hardware fundamentals, computer and application software, E-content and open educational resources, and data security.

ESBNU has experience in undertaking reviews on the use of technology in

teaching and learning and making changes and improvements in technology practices in the school based on the outcomes of these reviews. For instance, the Information Technology Center has established a communication mechanism among teachers, the Center, and the technology equipment manufacturers. When teachers find any difficulties in using devices, they would turn to the Information Technology Center to ask for assistance, or give feedback and suggestions. The Information Technology Center would collect and summarize teachers' feedback and suggestions and pass them to the product manager of Classin for further improvement and development of the product. The product manager of Classin would also go to the school and observe teachers' classes and provide suggestions and personalized training to teachers.

Capacity development

ESBNU prepares and supports its staff and teachers for new technology integration through continual professional development. The school has provided training programs regarding Information and Technology Literacy which includes an overview of the application of ICT in a general and, specifically, educational context, identifying possible information tasks that can be carried out with technology, and analyzing the strengths and concerns associated with ICT use. Besides the training programs provided by the school, the Beijing Municipal Education Commission also provides teacher training programs, both online and offline, regarding ICT in education, assessment, administration, and teacher professional development. The forms of the training vary, including webinars, online courses, online collaborative projects, online tutorials, and so on.

According to the interviews of both the vice-principal and the director of the Information Technology Center, teachers from ESBNU are proficient with the basic use of ICT in education and can facilitate lessons efficiently with digital tools. Currently, the technical mastery of ICT is no longer a problem for them, but how to incorporate ICT with appropriate pedagogical practices and select the most appropriate resources for daily instruction has become their priority. Resources such as teaching materials, lesson plans, and textbooks play a crucial role for any teacher collective work. Preparing lessons requires the teachers to investigate and develop multiple resources. During a regular session of collective preparation of instruction and lesson plans, teachers would take the opportunity to exchange ideas and insights regarding how to better integrate ICT into daily teaching, spontaneously exploring some innovative models, and currently are exploring the strategy of the flipped classroom with blended learning to better meet students' needs.

Learning Culture

ESBNU actively works to nurture and promote a strong learning culture where new technologies are infused. Teachers and administrators agreed that they wanted to strengthen the teacher learning culture at ESBNU. As a starting point, they decided to look more closely at ICT integration at their biweekly teacher meetings. They wanted the purpose of the regular meetings to be to look at student work together and learn from one another in terms of ICT integration. Teachers would be grouped according to

grade level and subject matter. Groups would range from three to seven people. Teachers would use a protocol to notice specific ways in which ICT related instructional choices were related to student learning. The protocol would ask participants to make claims about the level of student understanding and to support these claims with specific evidence from student work. Participants would also consider the instructional implications of their analysis of student understanding.
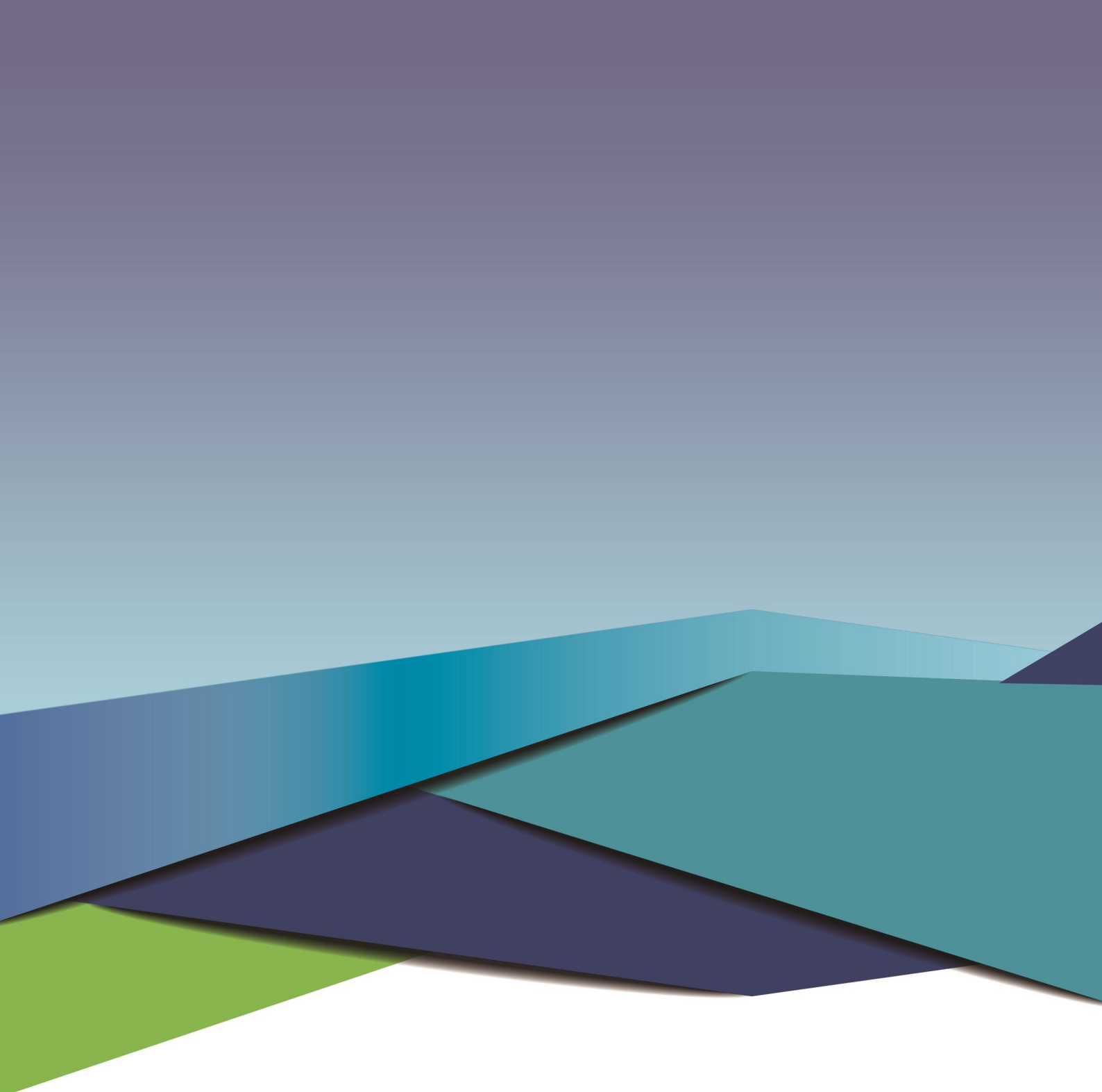
Furthermore, to build a learning culture and atmosphere for teachers to immerse themselves in, the school has built four smart classrooms. The director of the Information Technology Center stated that by creating an environment like this, teachers could have more exposure to cutting-edge technology and have more opportunities to explore ICT in innovative education and teaching.

External partnership and support

In 2012, China announced its first plan addressing ICT in education: the Ten-Year Development Plan on ICT in Education (2011-2020). The Plan contains the "Three Connections, Two Platforms" initiative, which refers to broadband connections in every school, connections to high-quality resources in every classroom, connections to online learning spaces for every student, and the two public-service platforms of educational resources and education management. The efforts of Government and schools over the past years have allowed schools to begin to build a wide-ranging and multi-level system of ICT in education, all aspects and indicators of which have seen exponential growth. Rates of internet access in primary and secondary schools nationwide have increased from 25% to 88%, the proportion of multimedia classrooms has risen from 40% to 80%, the number of computers per 100 pupils in primary and secondary schools has grown from 8 to 12, and the number of online learning spaces for teachers and students has surged from 600,000 to more than 63 million. Because of the policy implementation, the expenditure on technology equipment for the school mainly comes from the annual education budget from both the municipal and district governments.

Besides government's support, the school also made efforts to open pathways to external support and partnerships to foster the growth of the technology environment. ESBNU is willing to partner up with external organizations and tech companies to explore and try new technologies to support students learning and improve their academic outcomes. For example, ESBNU introduced the Classin platform when the COVID-19 pandemic hit and the school experienced closure during that time, using the platform to support students' learning, and continuing to use it when the school reopened.

ESBNU is considered as one of the most advanced schools in Xicheng District and has the best teaching staff, students and resources. Partnerships allow organizations or tech companies to reach students in need of support services, and to gain access to school resources, including facilities, student data, and curriculum, with the potential to improve their product or service quality.