Innovations in Information and Communication Technology-Enhanced and Competency-Based Education: Experience from Gansu Province, People’s Republic of China

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INTRODUCTION

The evolution of the knowledge economy relies on skilled “knowledge workers” to increase productivity and efficiency. The primary drivers of economic growth are the creation, distribution, and use of knowledge and information. Skilled knowledge workers are essential to this process, as they are responsible for generating new ideas and developing new products, services, and processes. Unlike manual laborers who perform physical tasks, knowledge workers solve complex problems through digital tools and techniques (Serrat 2008, Pont 2001).

The demand for knowledge workers has given rise to the “core competencies for the 21st century,” which are a set of skills and abilities that emphasize critical thinking and problem-solving, communication and collaboration, creativity, and innovation (OECD 2005, UNESCO 2015). Digital literacy, or the ability to use technology to find information, evaluate it, and produce new information, is an essential component to the core competencies (ADB 2014, Law et al. 2018). Critical thinking and problem-solving often require the ability to navigate complex digital environments and analyze large amounts of data. Communication and collaboration also require proficiency in digital tools and platforms, as many interactions now take place online.
This brief draws on the outputs of the Asian Development Bank (ADB) knowledge and support technical assistance (TA) for developing students’ core competencies and reducing rural–urban disparities in primary education using information and communication technology (ICT) in Gansu Province, People’s Republic of China (PRC). Implemented in 2019–2023, the TA project designed and delivered action research projects piloting three models of ICT-enhanced and competency-based education (CBE), namely, dual-teacher model (DTM), deep learning, and project-based learning (PBL). Action research in education is a systematic process of inquiry conducted by teachers or educational professionals to improve their teaching practices, student learning outcomes, and educational institutions’ overall effectiveness. This brief highlights key findings and recommendations from the action research projects for ICT-enhanced CBE and equitable education in urban and rural areas in ADB’s developing member countries.

COMPETENCY-BASED EDUCATION

There is a need for education systems around the world to respond to the need for knowledge workers, as well as the need to prepare children and youth to thrive in the 21st century with a broader set of skills and competencies along with academic knowledge (OECD 2018). One response has been the adoption of CBE, which emphasizes the development of practical skills, abilities, and behaviors necessary for performing specific tasks that define the core competencies, rather than just academic knowledge. For example, at the primary school level, critical thinking involves skills and behaviors for analyzing, evaluating, and synthesizing information to make informed decisions and solve problems. Such skills and behaviors are essential in many academic subjects such as science, technology, engineering, and mathematics.

CBE prioritizes students’ deep understanding developed through interactive hands-on activities that build core competencies (Evans, Landl, and Thompson 2020). The potential of CBE can be enhanced through ICT by providing students access to digital tools and resources that can support active learning. ICT can provide interactive hands-on activities and opportunities for collaboration while enabling students to develop digital literacy skills integral to their mastery of competencies. Expanding on the earlier example, critical thinking with the use of digital tools involves skills and behaviors evaluating online sources for accuracy and credibility.

Equity is a central goal of CBE as it provides a structure for personalized learning (Levine and Patrick 2019). Personalized learning recognizes that each student has unique learning needs, abilities, and interests that need to be supported throughout the learning process. This approach is particularly valuable in rural education, where class sizes may be smaller, allowing teachers to provide targeted support and address specific learning gaps (Chuong and Schiess 2016). Additionally, it is valuable in addressing gender differences in learning outcomes, allowing teachers to plan instruction around learning styles (Sturgis and Casey 2018). Under CBE, assessment takes place through mastery demonstration, which is one approach to personalized instruction. Instead of answering questions on a test, students show the extent to which they can apply skills and behaviors related to core competencies through the completion of tasks. For instance, critical thinking—coupled with communication skills—may be assessed through the creation of a report or presentation. Mastery demonstration allows students to progress at their own pace and demonstrate their ability and understanding in a way that makes sense to them (Passaro, Guskey, and Zahn 1994).

Education systems in developed countries have been adopting competency-based approaches since the 1990s. In the United States, CBE has been integrated in rural schools, which has enabled the inclusion of students with learning differences or disabilities into the regular classroom through personalized learning and meaningful assessment (Passaro, Guskey, and Zahn 1994). The use of ICT to enhance CBE is limited to well-resourced, higher-performing schools, which utilize a cloud-based digital learning management system (LMS) that collects and stores students’ data, helps plan personalized learning activities or projects and organize instructional support, and assesses students’ learning outcomes (Lee et al. 2021).

In terms of CBE implementation in developed countries, an important aspect that areas such as British Columbia, Canada; Finland; Scotland; and the United States have in common is that responsibility for education, including curriculum, is decentralized to the regional level. Education authorities at the regional level set their own curriculum in alignment with a national core curriculum. They also set their own standards, which include competencies and content for each area of learning (Bristow and Patrick 2014).

In developed country contexts, schools are responsible for contextualizing regional curriculum and standards into their own school-based curriculum to operationalize CBE at the classroom level. At the school level, some important facilitators that support CBE implementation include a priority for promoting student voice and choice in learning and mastery demonstration, and transparent expectations and standards among teachers and students. Key barriers include the teachers’ reluctance to change instructional methods and give students control over their learning, normative beliefs about assessment, and a lack of CBE models for schools to follow (Evans, Landl, and Thompson 2020).

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1 ADB. 2019. Technical Assistance to the People’s Republic of China for Developing Students’ Core Competencies and Reducing Rural–Urban Disparities in Primary Education through the Use of Information and Communication Technology.
PRIORITY FOR ICT-ENHANCED AND COMPETENCY-BASED EDUCATION IN THE PEOPLE’S REPUBLIC OF CHINA

Within developing Asia, the PRC has been implementing a CBE system since the early 2000s. There has been an evolution in the overarching educational goals set by the PRC Ministry of Education (MOE) from shuangji 双基 (foundational knowledge and skills) to suzhi 素质 (essential qualities), to the current goal of suyang 素养 (competencies) (Wang 2019). Curriculum reforms initiated in 2014 included the Core Competencies and Values for Chinese Students’ Development based on the “core competencies for the 21st century,” and contextualized by including cultural competence (Figure 1). The core competencies defined by the PRC MOE prioritize the development of students’ practical skills and innovative thinking while inculcating a sense of responsibility. This is a shift from focusing strictly on subject knowledge and examination scores. The Compulsory Education Curriculum Program and Standards initiated in 2022 emphasize core competencies as essential for lifelong learning.

The China Education Modernization 2035 reemphasized these priorities while recognizing disparities in the quality of a 9-year compulsory education (primary and lower secondary education) between urban and rural schools (Communist Party of China Central Committee and State Council 2019). Several programs have been launched to improve poor conditions in rural schools. However, better infrastructure only solves a small part of the problem. Teacher shortages are a serious problem in rural schools due to fewer chances for teacher promotions, and the lower quality of life in rural areas overall (OECD 2016).

To promote equitable compulsory education in terms of accelerating the reduction of the urban–rural gap, the PRC prioritized construction of ICT infrastructure for primary schools nationwide and built physical and virtual connections between rural schools and the broader education system through ICT. This has given a potential path for teachers in rural areas to participate in teacher communities and develop their teaching practices (Qiao 2018). The government also launched initiatives (Communist Party of China National Congress 2019) such as providing digital teaching resources made available by urban schools and teacher training on how to use technology in the classroom (Li et al. 2023, OECD 2016).

STATUS OF URBAN AND RURAL SCHOOLS IN GANSU PROVINCE

The PRC’s adoption of competency-based approaches in curriculum and the promotion of ICT to bridge the gap in education quality between urban and rural schools have been revolutionary. The responsibility for implementation is decentralized to the provincial and local education authorities, of which Gansu Province has taken steps toward implementation. In 2021, the Gansu Education Department released the Gansu Province Fourteenth Five-Year Plan for the Development of Education (Gansu Education Department 2021), which prioritized improving the quality of education to align with the demands of the new curriculum, inclusive of instructional methods such as PBL to inculcate core competencies.

Located in the northwest region of the PRC, Gansu is one of the less developed provinces with a lower level of urbanization and higher level of poverty (ADB 2019). Primary schools in Gansu are predominantly located in rural areas (Gansu Province Bureau of Statistics 2022). The Gansu Provincial Department of Education, together with the Lanzhou Education Bureau, aims to accelerate ICT-enhanced CBE while enabling equitable compulsory education. Lanzhou is recognized for its pioneering role in implementing curriculum reforms and bridging the gap between urban and rural schools with the use of ICT.

The TA assessment of urban and rural schools highlights the interdependence among (i) school culture, (ii) teacher capacity, (iii) school curriculum and evaluation, and (iv) ICT infrastructure.
and resources. These relationships in the implementation of ICT-enhanced CBE and reduction of disparities between urban and rural schools are shown in Figure 2.

Village primary teaching facilities are small classrooms located in the rural villages of Gansu. Such facilities commonly have limited resources and equipment. The following provides a comparative overview of the interdependence among the key elements in urban schools and village primary teaching facilities in Gansu.

School Culture
The education system of Gansu Province has been a predominantly traditional system prioritizing standardized testing. A shift in mindset through ICT-enhanced CBE is necessary for students’ success. Instead of focusing solely on how well students perform on standardized tests, there needs to be a shift toward emphasizing the development of competencies that will help students succeed in all areas of their lives. The TA assessment indicated that teachers from renowned urban schools and select rural schools are aware of the importance of students’ core competency development, and that such schools are beginning to shift from a focus on purely academic success to the development of competencies, with a particular focus on innovative courses. Teachers in urban schools are motivated to understand how to integrate CBE into the required subject classes, together with the use of ICT. Teachers in rural schools have a strong desire to improve their instruction toward a more student-centered approach or shifting the focus of instruction from themselves to the student. However, a high-stakes testing culture continues to exist. Teachers experience pressure to prioritize test preparation over the development of core competencies.

Teachers’ gender bias can also have a significant impact on school culture and can create a negative learning environment for students. Gender stereotypes are more prevalent in rural schools.

Teacher Capacity
Teacher awareness for ICT-enhanced CBE, their ability to integrate ICT into their teaching and learning practices, and their capacity to design and deliver competency-based instruction depend on their access to specialized training and professional development opportunities. Urban schools organize teacher development opportunities for ICT-related thematic teaching and action research on ICT integration into the teaching and learning process. For areas of professional development that school-based training cannot cover, urban schools provide financial support and teacher release time to attend professional development away from school. Some urban schools have established teacher research groups to coordinate action research and share resources. They also make available learning resources designed in-house to other schools within the same location while offering short workshops and peer-to-peer support.

Despite opportunities for teacher professional development, the TA assessment notes that urban teachers seem to struggle with aligning students’ core competency growth with their academic knowledge advancement in their instructional practice. Additionally, they struggle with using new ICT equipment, and they lack experience in integrating ICT into the teaching and learning process. However, urban teachers appeared experienced in “hierarchical teaching,” where students are divided into groups based on their academic performance. Teachers address learning differences and disabilities through such grouping.

Many rural school teachers still rely on teaching and learning methods that emphasize the acquisition of subject knowledge. Rural schools have very limited resources to design and deliver school-based teacher training. New and less experienced teachers are commonly supported by more experienced teachers. However, this approach is limited given the high teacher attrition in rural schools. While some rural schools benefit from receiving learning resources provided by urban schools, the lack of institutionalized relationships with urban schools makes it difficult to ensure continuous teacher learning opportunities. Rural teachers lack the capacity for planning and implementing student-centered teaching approaches, as well as for integrating ICT into the teaching and learning process.

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Figure 2: Key Elements of Information and Communication Technology-Enabled Competency-Based Education Toward Reducing Regional Disparities

ICT = information and communication technology.
Source: Asian Development Bank (East Asia Department).

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[3] In this approach, students are taught using a thematic approach, where lessons and activities are centered on a particular topic. At the same time, technology is used as a tool to support learning and instruction.
School Curriculum

School-based curriculum development is a developing practice among primary schools in Gansu with greater progress among a few urban schools. Urban schools have been able to formulate a school-based curriculum with learning resources to support delivery. Additionally, the shift toward CBE in urban schools has included the restructuring of subject-specific school curriculum. However, integration of competency-based approaches in subject classes is limited in urban schools due to teacher capacity. Very few urban schools have been able to systematize delivery of curriculum through ICT resources with means for evaluation aligned with curriculum goals and objectives.

Rural schools are in the initial stages of developing their school curriculum in alignment with core competencies. Instructional resources to support teachers in rural schools in adopting more student-centered, problem-driven, and PBL methods are scarce. Collaboration between rural and urban schools is not yet encouraged for planning, preparing, and delivering lessons. The use of formative and various assessment measures to track student progress and devise personalized instructional strategies are rare in both urban and rural schools.

CBE in urban schools, and in a few rural schools, has mainly been implemented through innovative special interest elective classes optional to students such as music and art. Students seem to enjoy such opportunities. Students are encouraged to think critically, engage in teams, and communicate ideas. CBE promoting creativity is a rarity among schools.

ICT Infrastructure and Resources

National and local policies have led to improvements in the ICT infrastructure in both urban schools and village primary teaching facilities. However, further improvements are necessary. Classroom learning is facilitated with interactive electronic whiteboards and multimedia devices that aid conventional teaching and learning methods. However, they currently lack the capacity to adequately support interschool collaboration and the seamless integration of online and offline teaching. The student–computer ratio is insufficient to enable independent use. Internet is available, but classroom-level applications that can be accessed online for regular teaching are lacking. Schools generally do not involve online learning.

Teachers use ICT more for delivering subject knowledge than for developing students’ core competencies. Various courses in information technology are offered to students in the lower grades; however, students in the upper grades have limited options. Some schools provide a wide variety of electives related to ICT, or those that require ICT support.

Since 2017, DTM has been implemented in Gansu. It makes lecture videos and other teaching resources from urban schools available through the internet to rural schools. While classrooms at urban and rural schools can now be linked via the internet, collaboration has yet to take place regularly. The average internet speed at schools cannot enable a stable synchronous classroom. Schools’ experience with DTM indicates that rural school students have difficulty following the teaching pace of the lead teacher in urban schools. Aside from internet lags, this difficulty is also due to the lack of coordination between the urban and rural school teachers to build awareness about student needs.

ACTION RESEARCH PROJECTS

Findings from the Dual-Teacher Model Pilot

Findings from the TA assessment informed the design of three pilot action research projects to enable 6 urban and 10 rural schools to explore (i) the implementation of DTM, (ii) CBE approaches in deep learning, and (iii) PBL. In the first pilot, the rural school teachers gain access to recorded lecture videos from an urban school and incorporate them into their own teaching activities by using the recorded lecture videos as a reference in preparing for their own lectures and/or using sections of the recorded lecture videos to illustrate certain concepts to the class. In essence, students are taught by two teachers (Li et al. 2023). For the second pilot, the goal of deep learning is mastery of content as defined by the curriculum while focusing instruction on critical thinking, problem-solving, and other “habits of mind” associated with the ability to acquire and use knowledge (Noguera, Darling-Hammond, and Friedlaender 2015). Meanwhile, PBL as covered in the third pilot refers to problem-oriented learning that is organized around projects (Thomas and Mergendoller 2000).

Given the need to strengthen teaching capacity in rural areas and the teachers’ strong desire to improve their instructional practices, all three sets of action research projects explored the formation of ICT-based professional learning communities and leveraged experience with teacher research groups. The action research projects also explored the development of competency-based assessment that enables mastery demonstration, and the development of a digital database of learning resources to support urban and rural schools.

The following discussion provides insights into the action research projects including the facilitators and barriers to the implementation of the three approaches in the context of Gansu. Policy recommendations for sustained implementation of CBE and bridging rural and urban schools toward ensuring access to quality CBE for all are discussed.

Findings from the Dual-Teacher Model Pilot

The action research on DTM implementation included one urban school and one rural school.4 Three experienced urban school teachers and three rural school teachers with 1–3 years of experience participated. Some urban school teachers were familiar with the challenges of rural schools as they had taught at rural schools during their careers. Both rural and urban school teachers had some experience in using ICT given the different resources available, and some understanding of CBE.

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4 Qilihe Primary School (urban) and Wangguanying Primary School (rural).
ICT resources necessary for both schools included projection TV and camera with microphone. Interactive display together with hardware and software tools for recording classes in real time was limited to the urban school. Both schools had access to an online learning management system (LMS) to upload and access class video recordings.

Pairs of teachers engaged in selecting topics, designing teaching plans, crafting learning activities, and engaging in discussions to optimize the teaching plans in three subjects (Chinese, Mathematics, and English). Teachers received collaborative support from a multidisciplinary team inclusive of subject experts, interdisciplinary learning experts, and an education technology specialist. Teachers collaborated and planned simultaneous teaching sessions with the team of specialists via WeChat group chat. Simultaneous teaching took place with urban classrooms connected to rural classrooms via the internet. Figure 3 illustrates the channels of interaction between classrooms.

Through the process, it was found that teaching design needs to be improved by incorporating comprehensive, wide-ranging learning activities to engage students in both locations. Student interaction between locations could then be supported through interconnected activities. This way, “near-end” and “far-end” teachers can share teaching responsibilities, creating an engaging learning environment that is relevant, diverse, and interconnected in dual teaching practices.

It was also found that for schools in rural areas, students needed lessons to be highly interactive. The students needed frequent opportunities to raise questions and exchange ideas. It was also found that teachers in both the rural and urban areas had a role in engaging student interaction. Both teachers needed to not only instruct but organize learning experiences and inspire students to engage during the simultaneous teaching sessions. Teachers in rural areas also needed to provide remediation to students who are unable to follow the instruction. During the simultaneous teaching sessions, internet connectivity at times was lagging, which prevented continuous connection between the two classes.

Teacher interviews conducted during the DTM pilot revealed that many teachers in both urban and rural areas believed that girls’ academic performance was dependent on hard work, effort, and discipline; and for boys, to intelligence, swiftness, and divergent thinking. It was perceived that girls start to fall behind academically due to lack of ability, and boys fall behind due to lack of willingness to study hard. Teachers also mentioned that because girls start puberty earlier, their attention is shifted away from studying to appearance and social relationships.

Findings from the Deep Learning Pilot in Competency-Based Education in Rural and Urban Schools

The action research on deep learning included two school groups: two urban schools and four rural schools. One of the urban schools had established over many years a professional development program for teachers on enhancing their teaching skills and incorporating research-based practices into their teaching methods. A team of experts associated with the established professional development program was identified to support the implementation of deep learning. Online training workshops for all teachers were conducted to introduce the theory behind deep learning and practical models for incorporating competency-based learning. Readings were provided to engage teachers further. Teachers exchanged ideas and perspectives—

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Figure 3: Dual-Teacher Model Interactions

![Figure 3: Dual-Teacher Model Interactions](source: Asian Development Bank (East Asia Department)).

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5 For urban areas: Dongjiao School and Northwest Normal School-Affiliated Primary School. For rural areas: Shanghua School of Yuzhong County, Mapo School of Yuzhong County, Gaoya School of Yuzhong County, and Houdiwan Primary School of Lintao County.
including learning differences observed among their students—through online discussion forums. Teachers engaged in online collaboration sessions with experts through an LMS for audio and videoconferencing, collaboration, and chat to design unit plans, including leveled interactive activities to address learning differences. All teachers video recorded their deep learning lessons. Recordings were made available through LMS.

During the process, it was found that teachers in rural areas were challenged by the concept of deep learning. Understanding of the concept was further complicated by the lack of subject matter knowledge and instructional design skills in terms of determining learning objectives, activities, and assessment. Foundational learning theory among some teachers in rural schools required strengthening as gaps in technical knowledge prevented some teachers from independently designing units of instruction. Additionally, teachers’ daily workload prevented them from implementing the action research project despite their motivation to participate. Workload included classroom instruction plus heavy administrative work, which was exacerbated by the burdens brought by the coronavirus disease (COVID-19) pandemic in the PRC. Burdens included travel restrictions, additional administrative work, and regular nucleic acid testing in most urban areas.

**Findings from the Policy-Based Learning Pilot**

The action research on PBL implementation included three urban schools and four rural schools, which worked together in three interschool groups. The urban schools had some experience with PBL and other innovative teaching and learning approaches, including experience in a smart classroom technology environment. The PBL initiatives among the three interschool groups were based on themes and ideas already existing at the urban schools, such as agriculture, digital art, and reading. Urban school teachers, along with experts, led rural school teachers through the process along with the students. Urban–rural teams of teachers coached students in digital literacy skills relevant to the PBL themes. Students were guided to use apps to support digital presentation and video production. The teachers observed that students are motivated through the PBL process, particularly when engaging in interdisciplinary aspects of the PBL activities. Students of both urban and rural schools collaborated with each other on research and engaged in problem-solving process related to their PBL activities through online forums. Student pre-assessments and post-assessments were designed.

Data collection and organization throughout the action research project for PBL was limited for each school group. Student assessments were designed, but student performance data was not used to inform the PBL process.

Instances of teacher gender bias was observed in the PBL pilot. Teachers overlooked students’ individual learning differences when attributing students’ learning difficulties to gender differences or differences in adolescence.

**POLICY RECOMMENDATIONS**

(i) **Create a supportive work environment for teachers.** As teacher perceptions influence school culture, it is critical for schools to support teachers by recognizing their efforts in adopting CBE approaches and incentivizing those who are successful in creating and engaging in opportunities for collaboration. Recognition and incentives can motivate teachers to continue their efforts. Additionally, schools need to allocate time for teachers to gain continuous professional development and to plan CBE learning opportunities, together with learning resources and assessments. Digital tools such as LMS and digital applications need to be considered to achieve efficiency in use of time and resources.

(ii) **Provide dedicated LMS for teacher professional development.** In both urban and rural schools, teachers require professional development accommodated to their levels in CBE, ICT integration, and personalized instruction and assessment. They also require training on unconscious gender bias, gender-sensitive teaching practices, and strategies for creating an inclusive classroom environment. Teachers in rural schools especially require training in foundational pedagogy. It would be prudent for schools to partner with teacher research groups, professional learning communities, and university partners to develop cloud-based digital training resources in a dedicated LMS to make opportunities for professional development available to all.

(iii) **Formulate policies and procedures for reforming school curriculum and developing competency-based assessment.** Rather than teach competency skills separately in elective classes, schools need to create a curriculum that integrates competencies into the core academic subjects. While it is crucial to invest in teacher capacity development, it is equally important to establish clear policies and procedures that guide the development of the school curriculum, including competency-based assessments. Policies and procedures can provide a framework enabling consistency across different subjects, grade levels, and classrooms.

(iv) **Formulate policies and procedures for expanded DTM implementation.** Policies and procedures can be formed to guide coordination between urban and rural schools with support from the regional education authority. Requirements for DTM can be highlighted in terms of a school needs assessment, school staff necessary and their roles in DTM, and DTM teaching and research activities. The regional

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6 For urban areas: Lanzhou Experimental Primary School, Lanzhou Branch of Beijing No. 2 Experimental Primary School, and Ningwuzhuang Primary School. For rural areas: Chigan Centre School of Zhouqu County, Wushengyizhen Centre School of Yongdeng County, Tongyuan Xiangxing Keqiaoxin School of Yongdeng County, and Hanjiaying Primary School of Yongdeng County.
education authority can supervise DTM implementation and share pilot experiences as a way to guide the schools to explore and apply it.

(v) **Invest in higher-quality ICT infrastructure and technical support for schools.** Though the ICT infrastructure has been improved for both urban and rural schools, internet connection remains unreliable. Schools hardly integrate online learning into classrooms and piloting of DTM stalls. Greater investment needs to be made to ensure a higher quality of ICT infrastructure. Reliable internet connection can help teachers explore interactive hands-on activities and tools for accurate competency-based assessment. It can also help to support collaboration between rural and urban schools. Technical support for schools is critical to optimize the ICT infrastructure as part and parcel of a school’s educational ecosystem.

**REFERENCES**


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