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Information technology for learning, education and training — Reference model for information and communications technology (ICT) evaluation in education

Technologies de l'information pour l'apprentissage, l'éducation et la formation — Modèle de référence pour l'évaluation des technologies de l'information et de la communication (TIC) dans l'éducation

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 36, *Information technology for learning, education and training*.

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Introduction

Information and communications technology (ICT) has been pervasive in the modernization of society. ICT in education has become integral to achieving quality learning and supporting lifelong learning. The Reference Framework for the Description of Quality Approaches (RFDQ) (ISO/IEC 40180) is an elaborate and extensive process model. It harmonizes existing concepts, specifications, terms and definitions for learning, education and training.

Evaluation of ICT in education is a key issue for policy and strategy development in education. It is also integral to quality assurance of ICT development in education, but also essential to management and decision-making.

This document provides a standard reference for evaluation reports, education policies, related research and significant issues related to ICT in education. As such it aims to support the quality processes related to ICT in education by informing governmental agencies, management organizations, local evaluation units and schools.

This document presents a scientific and rational indicator model and framework of ICT in education to support evaluation and development of ICT deployment in education. Specifically, this document aims to:

i)   establish an evaluation indicators framework for ICT in education with respect to data collection, performance monitoring and decision support services based on the investigation of typical ICT evaluation cases;

ii) outline approaches to reflect the development level of ICT in education for description or comparison between different regions or schools;

iii) take localized demand into consideration, proposing optional indicators and expanded indicators based on the information gaps.

Information technology for learning, education and training — Reference model for information and communications technology (ICT) evaluation in education

1 Scope

This document defines an abstract model and an indicator system framework for the evaluation of information and communications technology (ICT) in learning, education and training (LET). The abstract model accommodates requirements domains, including K12 education, vocational education, higher education and continuing education. The framework describes ICT service levels in the areas of learning, education and training, and aims to assist in quality processes associated with ICT in LET contexts.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
indicator
quantitative, qualitative or descriptive measure

3.2
performance
way in which an individual, group or organization carries out, accomplishes and fulfils its important functions and processes, usually with regard to effectiveness

3.3
evaluation
systematic determination of the extent to which an entity meets its specified criteria

4 Abstract model of the evaluation of ICT in education

4.1 Evaluation of ICT in education

Evaluation of ICT in education refers to the use of information technology and scientific performance assessment methods to reflect the development process and level of the implementation, execution, benefits or other aspects scientifically according to the goals and performance standards of ICT in education. The definition of evaluating indicators is beneficial in analysing the situation, achievements and limitations for the development of ICT in education.

The evaluation indicators of ICT in education have two levels: macro and micro. For the macro level, evaluation indicators provide scientific and reasonable assessment system and empirical data to reflect

the education development of one country or specific area. For the micro level, the evaluation indicators reflect the development of ICT in one school for students' learning abilities in ICT in class, the input and output of one school for the development of ICT in education and other aspects.

4.2 Abstract model

4.2.1 General

Figure 1 represents an abstract model framework of ICT in education, which contains core indicators, optional indicators and extended indicators. This abstract model contains three types of indicators which consider the regional differences and cover all types of education at all levels.

The abstract model follows these three principles:

i) Scientificity: The indicator system is mainly used to evaluate and guide the development plan and policy of ICT in education. The indicators need to follow the development rule of ICT in education and analyse each irreplaceable index comprehensively and systematically to avoid repetition and contradiction.

ii) Operability: It is important to consider the necessity of certain indexes and the convenience of collecting data. The connection of existing statistics and the data for the evaluation is beneficial for the reduction of cost to collect corresponding information correctly and in a timely manner.

iii) Sustainable development: The development of ICT in education is a dynamic process involving multiple stakeholders. The indicator system is iterative and provides direction for the development of ICT in education. As such, it is responsive to change according to the need of practice.
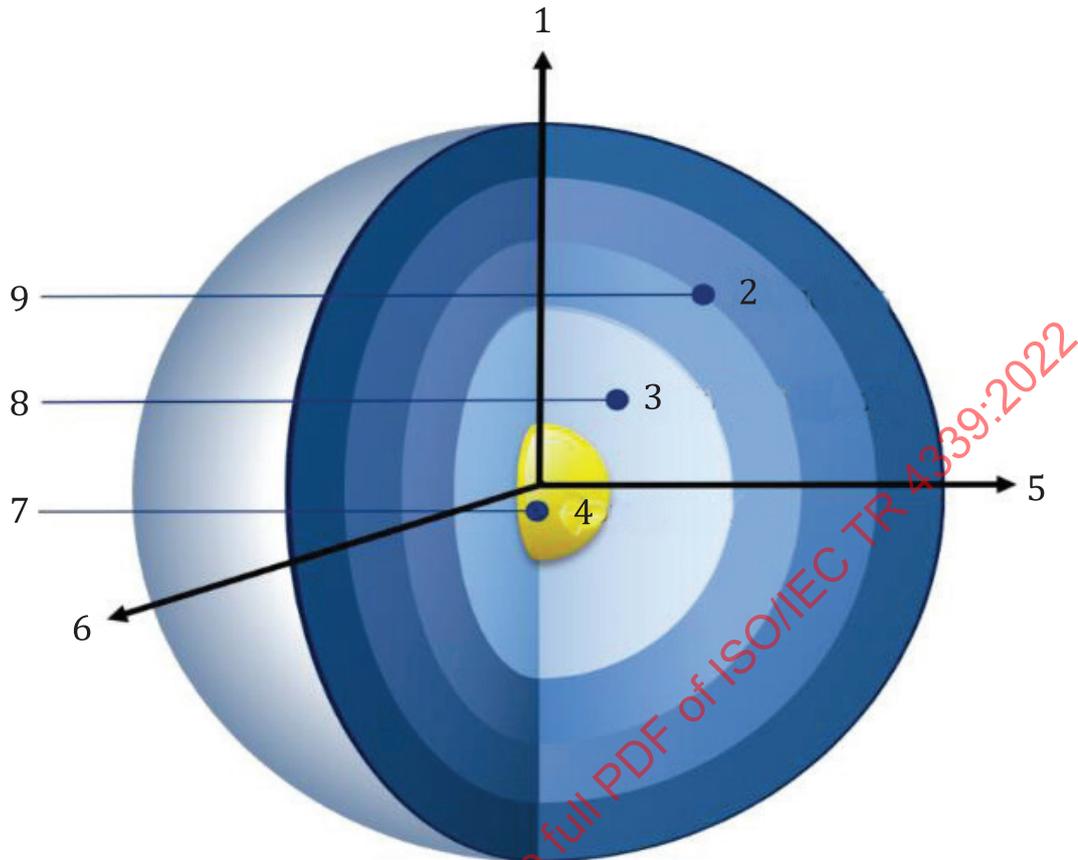
Key

1 evaluate applicability reduction
2 extended indicators
3 optional indicators
4 core indicators
5 evaluate details enhancement
6 evaluate accuracy improvement
7 designed for universal application
8 based on education type
9 combined with regional characteristics

Figure 1 — Abstract model of ICT evaluation indicator in education

4.2.2 Core indicators

Core indicators are indispensable for evaluating the situation and performance of ICT in education at school or regional level. The core indicators reflect the requirements of national plans for education reform and development and include five dimensions: ICT infrastructure, digital resources, application in teaching and learning, ICT-based management and guarantee mechanism.

4.2.3 Optional indicators

Optional indicators reflect the specific needs of basic education, vocational education, higher education and continuing education. Different levels of education have various needs, for example, basic education emphasizes diversification and personalized learning, vocational education pays more attention to training and simulation training and collaborative research based on networks is more popular in

higher education. Optional indicators provide a set of indicators which allow the evaluation organization to select the appropriate indicators according to their specific requirements from core indicators.

4.2.4 Extended indicators

Extended indicators allow schools to consider local construction requirements and put forward indicators to reflect development characteristics of ICT in education to supplement core and optional indicators. The specific content of extended indicators is not indispensable in the indicator framework, but the framework indicates the direction of the development. The extended indicators can be broken into ICT infrastructure, digital resources, application in teaching and learning, ICT-based management and guarantee mechanism.

4.3 Indicators for candidates

Different districts have their own objective in education, so indicators used to evaluate ICT in education across jurisdictions. According to the abstract model described in 4.2 and referring to the typical international ICT evaluation indicators in education (see Annex A), Table 1 gives some candidate indicators to guide the administrator and third-party evaluators.

Table 1 — Indicators of ICT evaluation in education for candidates

|	First level	Second level
Core indicators	ICT infrastructure	Exit bandwidth that have access to average school (Mbps/school)
		Proportion of classrooms with projectors in total number of classrooms in school (%)
		Proportion of computer classrooms in total number of classrooms in school (%)
		Proportion of schools establishing network security system (%)
	Digital learning resources	Proportion of schools building school-based resource (%)
		Quantity of digital learning resources for students (giga-bytes/student)
	Application of ICT in teaching and learning	Types and quantity of ICT activities carried out by teachers (number)
		Proportion of teachers registered in learning space (%)
	ICT-based educational management	Proportion of schools building information portals (%)
		Number of commonly used management information systems (number)
	Guarantee mechanism	Proportion of schools with chief information officer system (%)
		Proportion of schools with ICT management mechanism (%)
		Proportion of ICT investment in total annual education investment (%)
		Number of full-time ICT teachers (number)
		Ratio of teachers' ICT teaching application ability to the standard (%)

Table 1 *(continued)*

Optional indicators	Virtual simulation training system	Types of virtual simulation training system used by teachers (number)
		Frequency of virtual simulation training system used by teachers (times/week)
	Digital research platform	Proportion of schools using digital research platform in the study (%)
		Types of academic document, digital books, periodical articles
		Collaborative teaching and research system (number)
	Official online system	Proportion of schools using course selection and teaching evaluation online (%)
		Proportion of schools with recruit teaching staff system (%)
		Proportion of schools with entrance and transfer system (%)
		Proportion of schools with the arrangement of digital equipment system (%)
		Proportion of schools with the arrangement of experimental equipment system (%)
Extended indicators	Public service platform	Proportion of schools participating of educational resources public service platform (%)
	E-card system	Number of functions commonly used in all in e-card system (number)

5 Framework of the evaluation indicator of ICT in education

5.1 Indicators framework

The framework of the evaluation indicator of ICT in education includes five main dimensions, as shown in Figure 2.
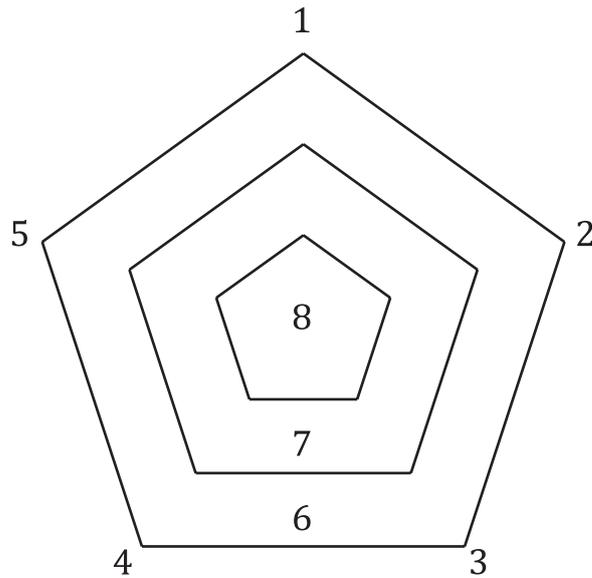
Key

1   ICT infrastructure
2   digital resources
3   ICT-based management
4   application of ICT in teaching and learning
5   guarantee mechanism
6   extended indicator
7   optional indicator
8   core indicator

Figure 2 — The framework of the evaluation indicator of ICT in education

— ICT infrastructure refers to the basic facilities, including hardware and software for internet connection and network.

— Digital resources refers to the construction and application of teaching, learning and research resources for all types of schools and management institutions.

— Application of ICT in teaching and learning refers to teachers' ICT capability and the usage of digital resources, learning systems and pedagogy.

— ICT-based management refers to the construction and application of management systems which provide a service platform for education management in schools and administrative departments.

— Guarantee mechanism refers to the policies, expenditure on ICT, talents team, mechanism supporting and ICT support services in construction and the implementation of ICT in education for all levels of schools and administrative departments.

5.2   How to use the indicators

Core indicators offer suitable indicators with general applicability for different schools at all levels and types from five dimensions, including ICT infrastructure, digital resources, application of ICT in teaching and learning, ICT-based management and guarantee mechanism. All regions and different kinds of schools can use core indicators to measure the corresponding development situation of ICT development in education.

Optional indicators mainly reflect the particular needs for schools of all levels and types. Combined with the core indicators, optional indicators allow the assessment agencies to choose the appropriate indicators according to needs.

Considering the differences between practical needs, extended indicators allow regions or schools to make their own indicators that can fully reflect local education characteristics as a supplement to the core and optional indicators.

Annex A
(informative)

Assessment indicators of ICT in education

A.1 School technology and readiness chart

The school technology and readiness (STaR) chart is designed by the CEO Forum on Education and Technology. By 2001 the CEO Forum had published four reports[4]. The CEO Forum revises and expands the STaR chart every year. The series reports concentrated on different fields of the development of ICT in education. The reports mainly focused on the infrastructure of ICT and the internet connecting in the first year. The second year, the reports concentrated on teachers' professional development. The third year, the reports aimed at the integration of digital resources and teaching. The fourth year, the reports focused on the achievement and evaluation of students' performance. According to the content of the series reports, the forum published the assessment indicators from four assessment dimensions: infrastructure in ICT and internet connecting, teachers' professional development, digital resources, students' achievements and evaluation, as shown in Table A.1.

Table A.1 — STaR focus areas

Key areas	Focus areas
Teaching and learning	i) patterns of classroom use; ii) frequency/design of instructional setting; iii) content area connections; iv) technology applications Texas Essential Knowledge and Skills implementation; v) student mastery of technology applications; vi) online learning
Educator preparation and development	i) professional development experiences; ii) models of professional development; iii) capabilities of educators; iv) access to professional development; v) levels of understanding and patterns of use; vi) professional development for online learning
Leadership, administration and instructional support	i) leadership and vision; ii) planning; iii) instructional support; iv) communication and collaboration; v) budget; vi) leadership and support for online learning
Infrastructure for technology	i) students per computer; ii) internet access connectivity speed; iii) other classroom technology; iv) technical support; v) local area network, wide area network; vi) distance learning capacity

The STaR chart helps schools to solve the following problems for the development of ICT in education: What is the development level of IT in the school? Does the school effectively use ICT to achieve high-quality teaching? What progress has the school made during the integration of ICT and education?

After the CEO Forum's four reports were published, the STaR chart became widely used in America. Under the promotion of the CEO Forum, some states and schools used the STaR chart to measure the development situation of ICT education in regions and schools. Based on the STaR chart and the actual needs of regional development, some states and organizations designed new indicator charts. For example, Texas created a new chart and tools according to the regional characteristic based on the STaR chart[5].

A.2 The Self-Review Framework

In 2006, in order to prepare to assess the real effect of technology-integrated education, the British Educational Communications and Technology Agency (BECTA) published the Self-Review Framework (SRF) of technology-integrated education. The SRF was recognized by every level of society and became the British authoritative assessment indicators system aimed at school automation.

The advantages of using SRF assessment indicators are as follows: i) schools can learn about ICT in education themselves, and find out differences with other schools; ii) schools can also get a series of advice to help to improve the level of ICT in education; iii) ensuring the prior direction and goals of development; iv) schools can utilize ICT technology safely; v) ensuring that schools' ICT investment is able to yield benefits; vi) schools can communicate every SRF indicator's implementation status with education management departments in time; vii) SRF can help schools to create an ICT development blueprint; viii) the result of assessment can maintain people's confidence in schools, including staff, parents, government leaders and students.

The latest six parts of the SRF include leadership and management, use of ICT in the curriculum, teaching and learning, assessment of digital capability, professional development and resources. Teaching and learning and assessment of digital capability are the significant factors to improve the ICT ability of students. Leadership and management is the most basic protection for developing every technology-integrated education factor[6],[7]. It promotes the level of teaching and learning with curriculum, resources and teachers' professional development. The assessment indicators, the aims of SRF and the relationship between factors are shown in Figure A.1 and Table A.2.
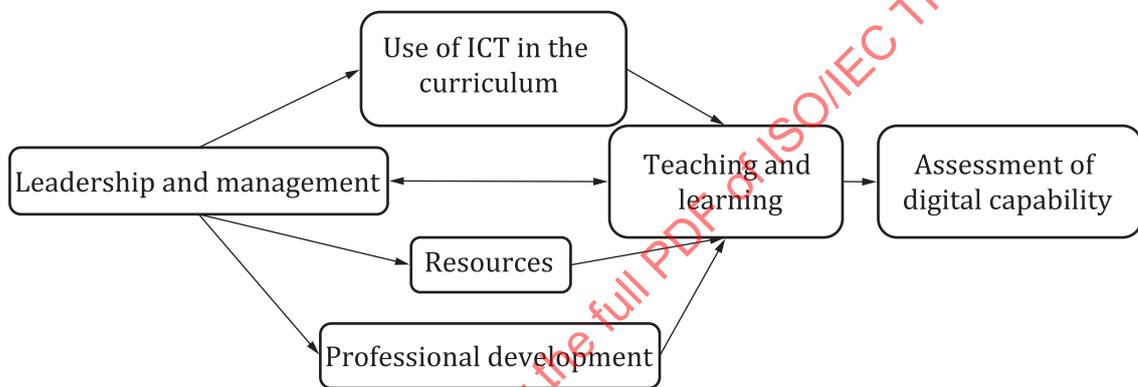
Figure A.1 — Relationship between factors

The Self-Review Framework is maintained by Naace with reference to the Self-Review Framework steering committee. The purpose of the SRF is to support school improvement through a reflective practice that allows schools to measure and improve their provision against a well-researched and evidenced set of criteria such that pupils become digitally literate. Table A.2 shows the vision published in January 2014.

Table A.2 — Self-Review Framework focus areas

Elements	Contents
Leadership and management	ICT and the school vision
	A strategy to achieve the vision
	Strategic use of data
Use of ICT in the curriculum	Strategic approaches to the use of ICT in the curriculum
	Leadership of ICT in the curriculum
Teaching and learning	Teaching and the learning process
	Pupils' learning experiences
Assessment of digital capability	Assessment of digital capability
Professional development	Developing and sharing digital capability
Resources	Provision
	Management of ICT resources

A.3   UNESCO's performance indicators of ICT in education application

The United Nations Educational Scientific and Cultural Organization (UNESCO) is devoted to increasing ICT education application in developing countries, carrying out activities in member countries relating to education development through using ICT technology.

Since 2005, the ICT Partnership of Promoting Development Alliance, consisting of the International Telecommunication Union (ITU), the Organization for Economic Co-operation and Development (OECD), the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Educational Scientific and Cultural Organization (UNESCO), has worked out and published ICT core indicators. The ICT Core Indicators Report of 2010 listed nine education ICT indicators[8], as shown in Table A.3.

Table A.3 — ICT core indicators 2010 (ICT in education)

No.	Core indicators on ICT in education
ED1	Proportion of schools with a radio used for educational purposes
ED2	Proportion of schools with a television used for educational purposes
ED3	Proportion of schools with a telephone communication facility
ED4	Learners-to-computer ratio in schools with computer-assisted instruction
ED5	Proportion of schools with internet access by type of access
ED6	Proportion of learners who have access to the internet at school
ED7	Proportion of learners enrolled at the post-secondary level in ICT-related fields
ED8	Proportion of ICT-qualified teachers in schools
EDR1	Proportion of schools with electricity

These indicators about ICT in education assessment have very important significance in driving ICT in education development assessment tasks and promoting the application of ICT around the world, especially the construction and application of ICT in education in developing countries.

A.4   China indicator system for education monitoring, assessment and statistics

In 2015, China's Ministry of Education published an indicator system of education monitoring and assessment statistics. This was a revision of the original 1991 version. The revision included advice from all the departments in the ministry of education, educational administration at provincial level, related universities, scientific research institution, experts, scholars and National Education Advisory Committee members. The ministry then improved monitoring indicators and further calculated the indicators.

The indicator system was divided into five parts, 102 items, after revising. Compared with the previous version, it retains nine original indicators, revises 18 items and increases 75 items. After the revision, 12 items are in common use in international organization, including gross entrance rate and net entrance rate. Nine items use the experience of international education indicators, and they are adjusted based on the need of China educational statistics work and practical situation, such as the new average years of schooling of labour force and first employment rate of graduates. Specific indicators can be seen in Table A.4.