Education for the Future:
The Global Experience
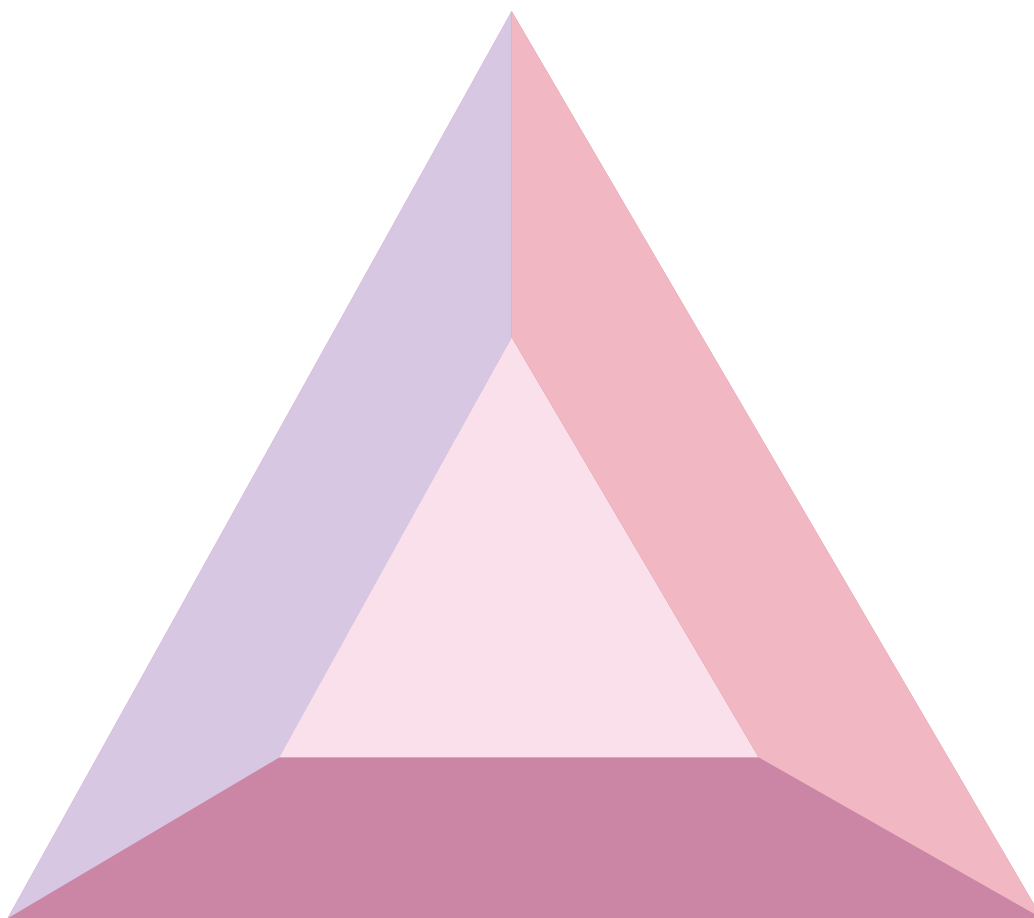# of Developing 21st Century Skills
and Competencies

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FOREWORD

The clear consensus among educators and policy makers the world over is that education is the single most productive investment a society can make toward the empowerment of individuals and communities, and for the lasting security and prosperity of the nation. Yet disruptive change in recent times raises urgent questions about what skills, competencies, and knowledge are needed to fulfill the promise of education in today's world and beyond. The remarkable rate of technological innovation and advancement, including especially the speed and efficiency of communications and connectivity, and related social and economic change, has had ongoing, profoundly transformative impacts on how we, as individuals and communities relate and interact across the globe. This reality confronts a stubborn legacy of education rooted in the past, when schooling arose in service of an industrial age. In post-colonial times, many other nations, regardless of their stages of development, adopted and sought to impose similar nineteenth century, western models of education in their societies, often lacking regard for practical needs of the community.

Today, a wide range of education stakeholders from cognitive neuroscientists to school leaders have advanced their many perspectives on how learning occurs, how to 'make things happen' in the classroom, how to improve teacher training, and how school systems should be reformed. Some have focused on life-long learning outside the conventional classroom, and have brought creative, technology-aided approaches to the unique needs of underserved and vulnerable communities, often in rural areas of developing countries.

For governments, the challenge comes in distilling and evaluating experience and expertise to create education policy visions that can drive economic growth, support improvement in people's lives, and build social cohesion. Governments have put forward their frameworks of education priorities attuned to those perceived needs of communities and economies today and anticipated in the future. This report has gathered a number of frameworks produced by regional groups of economies to examine, compare, and synthesize their priority skills and competencies for twenty-first century education. The report is a unique, useful resource that highlights the diverse range of perspectives and values reflecting regional, cultural, and historic realities.

The authors' unusual and timely investigation offers education stakeholders of all varieties an important comparison among global policy visions and outlooks in education. The report's observations on the need for increased government support, with school autonomy, teacher development, and other core recommendations that emerge from the frameworks analysis, make this research a valuable contribution to what remains, as the authors note, an area ripe for further investigation and elaboration.

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EXECUTIVE SUMMARY

This report aims to provide policy makers, education leaders, and researchers with a comprehensive understanding of the formulation, meaning, and implementation of twenty-first century competencies around the world. Competency frameworks from five international organizations and 24 economies were investigated and the official references cover more than eight languages. There are five important objectives of this research:

1. To identify the driving forces behind these competencies,

2. To analyze the elements and structure of these frameworks,

3. To investigate the implementation of these frameworks in education,

4. To discuss necessary support from government and social sectors,

5. To inspire strategies and ideas to promote, develop, and apply these competencies.

Firstly, the driving forces reveal what an organization or economy sees as a major challenge and the reason why it pursues twenty-first century competencies. In our analysis, ten important driving forces for implementing twenty-first century competencies were divided into three categories: the Era of Rapid Technological Transformation, Economic and Social Development, and Educational Development. Two comparisons have been conducted as follows: (1) The levels of focus for driving forces were analyzed among the 29 organizations and economies. We found that globalization, knowledge age, scientific and technological development and the information age, economic growth, occupational competencies and education quality improvement are the common forces shared globally. Demographic changes, multiculturalism, environment and sustainable development and educational equity reflect challenges faced by a few countries or regions. (2) Comparisons were

made among the driving forces and competencies of 15 high-income economies and nine middle-income economies. It is found that regardless of income level, all economies face the pressure of scientific and technological development and the information age, economic growth, occupational competencies and education quality improvement. High-income economies are comparatively more concerned with globalization and knowledge age; the middle-income group of economies faces more pressure around concerns for education equity, the environment and sustainable development.

Secondly, key representative frameworks are presented to showcase their unique characteristics. As the subjects of the research, a total of 29 frameworks are selected from these international organizations or economies. A total of 18 competencies were consolidated from an analysis of the 29 frameworks. They are classified in two domains: Subject-specific Competencies and General Competencies. Two comparisons have been made as follows: (1) The levels of concern for competencies were analyzed among the 29 organizations and economies. It is found that seven competences have gained attention from most organizations and economies, which include communication and collaboration, information competence, creativity and problem solving, self-perception and self-control, critical thinking, learning skills and lifelong learning, civic responsibility and social participation. Competency frameworks are characterized by inclusiveness, comprehensiveness and diversity, a reflection of the trend to cultivate the "whole-person". However, competencies like environment, finance, life planning and well-being and leadership, which are considered important in future education development, are not incorporated in many frameworks. (2) Comparisons were made among the competencies of 15 high-income economies and nine middle-income economies. Regardless of income level, most countries or regions have incorporated competencies like language, mathematics, humanities, sports and health, critical thinking, communication and collaboration, civic responsibility and social participation. High-income economies pay comparatively special attention to several competencies, such as information, creativity and problem solving, cross-cultural competence, and especially self-perception and self-control. Competencies like science and technology, art, the environment, and especially learning skills and lifelong learning, have become the focus of the middle-income group. Financial competence, life planning and well-being and leadership appear only in frameworks of high-income economies, with a limited frequency.

Thirdly, the implementation of twenty-first century competencies frameworks in the countries or regions is described in four areas: (1) curriculum design (incorporating competencies into disciplinary

courses, selecting interdisciplinary themes and developing learning and teaching resources); (2) teaching and learning (promoting student-centered learning, and advocating problem- or project-based learning); (3) assessment (conducting formative assessment to monitor and promote students' progress, designing competency-oriented tests and assessment, and utilizing professional certificates to evaluate competencies).

Lastly, many organizations and economies are making efforts to build support systems for different levels of twenty-first century competencies. Their strategies and experience can be summarized as follows: (1) providing government policy support for competency education, either focusing on all competencies or some specific ones; (2) strengthening autonomy, including granting more autonomy to local education bureaus, schools and teachers, cooperating with research institutes or NGOs; (3) using social resources, offering students with authentic learning opportunities and integrating competency education into vocational education; (4) strengthening teacher training, including providing more resources and applicable tools to teachers.

In order to advise policy makers and education leaders, in the end of each section, we recommend strategies and ideas to promote, develop and apply these competencies:

(1) Policy-making should be founded on a comprehensive, in-depth analysis of the driving forces with a global vision. When determining the driving forces, societies should fully consider their levels of socio-economic development, cultural traditions and geographical features. Education policies based on driving forces need to center on the nature anddevelopmental needs of children.

(2) Competencies should keep up with the requirement of times, global trends, regional demands, and local educational goals. The meaning of competencies should be precisely interpreted and a hierarchical and systematic network within and among competencies should also be established. The framework and education practice of twenty-first century competencies should feature lifelong learning. Time-tested competencies are also important in addition to the emerging ones.

(3) It is important to integrate twenty-first century competencies education into curricula and developing supporting teaching resources. We need to transform teaching methods with more focus on student-centered and problem or project-based methodologies. Also, diverse assessment measures should be implemented to lead and promote twenty-first century competency education.

(4) It is essential to consider the identification of driving forces, the selection of competencies, and the establishment of practices and support systems when designing the system of competency education. It could be realized through setting up an all-dimensional support system inside and outside the education system; exploring more effective professional development paths for teachers; developing systematic solutions that are replicable and scalable.

Finally, we conclude that many issues are worthy of further study, such as fundamental questions about what competencies are needed today and in the future and how could they be developed. The traditional Chinese philosophy could offer an alternative on these issues. First, "dealing with changes with changelessness" (coping with shifting events by sticking to a fundamental principle/policy) inspires us to reflect what makes time-tested competencies considering the cognitive development of children, while new competencies are continuously emerging. Second, the whole-person development is not simply a total of these competencies. It remains a question to us: What does a "whole person" mean and how could it be cultivated?

#1
INTRODUCTION

#1 INTRODUCTION

At the turn of twenty-first century, organizations and economies were asking an important question: What competencies should citizens develop for the needs of the new century? To answer this question, numerous frameworks for twenty-first century competencies have been published by organizations and economies. Many of these competencies have been adopted as educational goals or reforms to nurture talents and skills. The organizations or economies use various terms to describe the goals they are pursuing:

Table 1: Terms used by organizations or economies

Term	Organizations/Economies
21st Century Skills	Partnership for 21st Century Skills of US
21st Century Competencies	OECD, Singapore
Key Competences	European Union
General Capabilities	Australia
Generic Skills	Hong Kong SAR, China
Core Competencies	Chinese Taiwan, Mainland China

For the purpose of the current study we would like to use the terms "twenty-first century skills and competencies" or simply "twenty-first century competencies". We believe that competency is not limited to cognitive elements (involving theory, concepts, or tacit knowledge), but also encompasses functional aspects (technical skills) as well as interpersonal attributes (social or organizational skills) and ethical values. A competency is, therefore, a broader concept that may actually

comprise skills, attitudes, and knowledge.[1]

I. RESEARCH QUESTIONS

The research is centered on the following four questions:

1. What are the forces driving organizations or economies to pursue the competencies?

2. What are the elements of these competencies frameworks, their similarities and differences?

3. How were the competencies frameworks implemented, and what were the experiences of the policy makers and education leaders of the organizations and economies in developing these competencies?

4. What support systems are needed to develop the competencies in citizens?

Sections two through five respond to the above questions. We believe the responses to these questions will provide policy makers, education leaders and researchers with a comprehensive understanding of twenty-first century competencies, and inspire strategies to promote, develop, and apply them.

II. RESEARCH SUBJECTS

All-together, 29 frameworks are included in this study. We have reviewed the official publications on twenty-first century competencies frameworks of five international organizations and 24 countries or regions (hereafter referred to as economies), and we note the following two points:

1. The frameworks represent organizations or economies located on different continents.

We believe studying frameworks from different continents provides a more comprehensive, global portrait of the competencies. We included one representative framework from each of the five international organizations in our research: United Nations Educational, Scientific and Cultural Organization (UNESCO), Organization for Economic Co-operation and Development (OECD), European Union (EU), World Bank, and

The Asia-Pacific Economic Cooperation (APEC) and each of the 24 economies from six continents as shown below. Together, the selected economies represent a wide range of cultural and historical backgrounds.

Table 2: Economies selected for this study Continent Economies

	Continent	Organizations/Economies
1	North America	USA, Canada
2	South America	Brazil
3	Europe	United Kingdom, France, Finland, Russia
4	Oceania	Australia, New Zealand
5	Asia	Mainland China, South Korea, India, Japan, Qatar, Israel, Chinese Taiwan, Hong Kong SAR, China,Singapore, Indonesia, Malaysia, Philippines, Sri Lanka, and Thailand
6	Africa	South Africa
Total	6	24

The inclusion of more economies from Asia, Africa, and South America in this study provides more substantive research and potential findings compared with previous studies.

2. The economies are at different development stages.

Economies at different stages of development have distinctive priorities in education, which influence their education objectives in forming a framework for twenty-first century competencies. According to the World Bank statistics of per capita Gross National Income (in US Dollars, 2014)[2], we divided the 24 economies into two groups: 15 high-income ones, and nine middle-income ones. We believe the inclusion of middle-income economies may be a meaningful expansion of previous studies.

III. RESEARCH METHOD

We analyzed the official publications by five international organizations and 24 economies as shown in Figure 1.

To begin, we used education reports and other authoritative documents on websites of international organizations, economies, and their ministries of education. Secondly, we used documents from other influential education organizations such as non-education government departments (e.g. US Department of Labor), industrial confederations (e.g. Confederation of British Industry), authoritative research institutes (e.g. Japan's National Institute for Educational Policy Research) and important social organizations (e.g. Canadians for 21st Century Learning & Innovation). The documents we used were in English, Chinese, Korean, Russian, French, Portuguese, Japanese, Finnish, etc.

We used literature analysis to identify the driving forces for the twenty-first century competencies of the five organizations and 24 economies. We identified the forces from either the single most authoritative document or from across a group of them. All the identified driving forces were given priority in existing documents, and they represented key considerations in forming the competencies. Ten important driving forces divided into three categories (Era of Rapid Technological Transformation, Economic and Social Development, and Educational development) are summarized. We then made a statistical analysis to reveal the different levels of concerns for the driving forces among the frameworks.
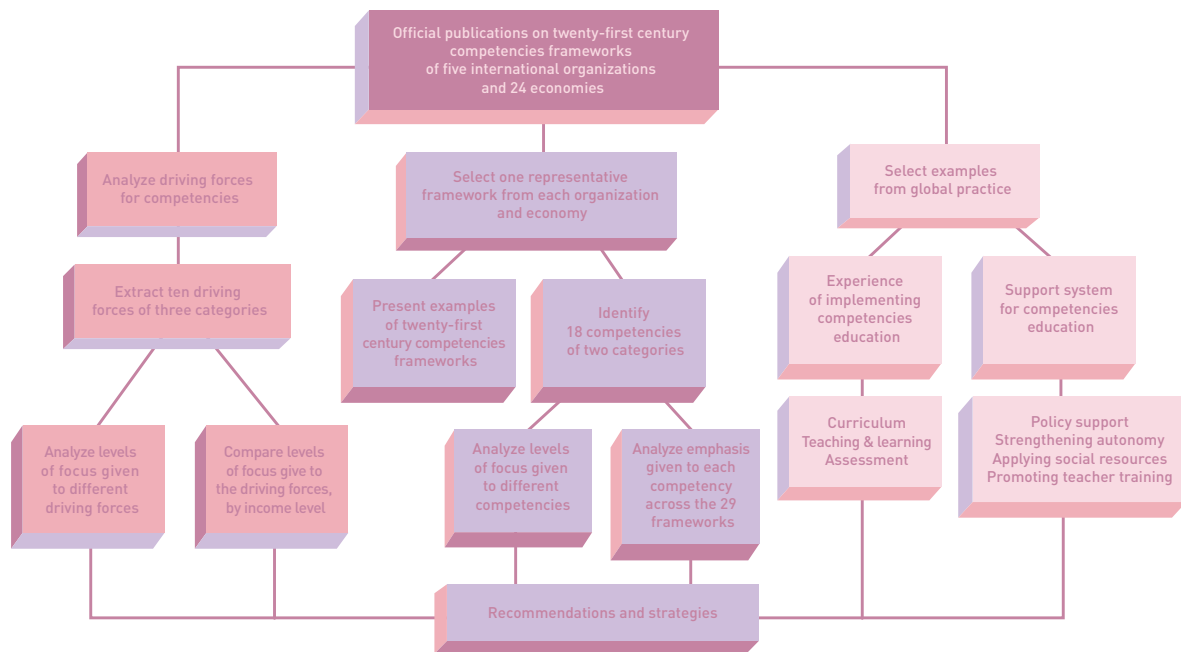
Several representative frameworks are presented including that of OECD, EU, US P21, Singapore, Hong Kong SAR, China, Mainland China, and Russia to help readers learn about the features of them. To make the statistics comparable when studying the levels of emphasis given the competencies among the frameworks, we took into account only one framework from each organization or economy, so that 29 frameworks are selected. For international organizations or economies with several frameworks, selection criteria are as follows: (1) Latest version of the document from each organization or economy; and (2) the official framework proposed by the education department is given priority. If there is no access to the official documents, we chose an alternative one in terms of authority, completeness, and influence. Then a total of 18 competencies were consolidated from analysis of the 29 frameworks. They are classified in two domains (Subject-specific Competencies and General Competencies). We count the frequency of each competence and made a statistical analysis to reveal the different levels of concerns for the competencies. The frequency count was limited to the competencies clearly listed in the frameworks. No further interpretation or extraction was involved (otherwise all competencies would be presented in different forms) in order to reflect the different priority levels.

Case portraits were presented to depict the implementation of the competencies in three areas (curriculum, teaching and learning, and assessment). Case studies show that support systems need to be established by both governments and social sectors from four aspects (government policy support, strengthening autonomy, social resources, and teacher training). Furthermore, to provide qualitative analysis and case studies of the elements the competencies and their driving forces, more materials are included, such as all relevant reports of each organization or economy. In this way, we approach a comprehensive, global picture of the twenty-first century competencies.

Lastly, we recommend strategies and ideas to promote, develop, and apply these competencies in each section of the report.

#2

DRIVING FORCES FOR TWENTY-FIRST CENTURY COMPETENCIES

#2 DRIVING FORCES FOR TWENTY-FIRST CENTURY COMPETENCIES

What kinds of skills and talents should be nurtured to embrace education challenges today and in the future? What competencies should learners acquire? These are the perennial questions societies ponder. The stakes are high when we try to identify the future direction for education and set development goals accordingly. Demands from all sides must be considered, including demands to acknowledge and understand change, the transformations in science and technology, the demands for social and economic development, and challenges in the education sector. These driving forces of twenty-first century competencies affect the frameworks and their connotations. This section presents various perspectives from which international organizations and economies identify the driving forces, their common characteristics and differences including suggestions of how to identify the driving forces.

I. THE DRIVING FORCES BEHIND THE COMPETENCIES

The key items related to the driving forces have been drawn from the official documents of five international organizations and 24 economies through literature analysis. We combined those items with identical or similar connotations. For example, we grouped "low academic achievements in poor areas" with "high dropout rate in poor areas" under "equality in education." Then we conducted a frequency analysis of the driving forces.

According to the analysis, economies around the world prioritized ten driving forces which fall into three categories (Figure 2).

Figure 2: Three categories of driving forces for 21st century competencies

DRIVING FORCES FOR TWENTY-FIRST CENTURY COMPETENCIES

Change and transformations in science and technology
Force 1: Globalization
Force 2: Knowledge Age
Force 3: Scientific and Technological Development

Economic and Social Development
Force 4: Economic Growth
Force 5: Occupational Needs
Force 6: Demographic Changes
Force 7: Multicultural Trends
Force 8: Environmental and Sustainable Development

Educational Development
Force 9: Education Quality Improvement
Force 10: Educational Equity

Change and transformations in science and technology

The transformations taking place today in science and technology have exerted significant impact on people's lives and work, and pose new requirements for competencies. Globalization, the Knowledge Age, Scientific and Technological Development and the Information Age are driving forces pressing for change in education priorities, for new competencies frameworks to meet contemporary challenges. In this process, there are both opportunities and challenges.

Force 1: Globalization
Globalization is a process of connection, interdependence and interaction among people, which leads to expanded global awareness[3]. Since the 1990s, with its increasing influence on societies, globalization has become a key concern to political, educational, social and cultural

organizations everywhere. UNESCO holds that while contributing to economic prosperity, globalization also poses risks to political, economic, and social stability. Globalization is currently proceeding at rapid rate. In order to thrive, people must improve their competencies, upgrade skills, and adapt to global competition and future challenges. People must learn how to co-exist with one another so that globalization will enrich instead of impede the interests of mankind[4]. Hong Kong SAR, China, for example, is undergoing profound change in all aspects of its society. The economic structure is changing with a knowledge economy becoming mainstream.

Force 2: Knowledge age

The knowledge age is a natural extension of the agricultural age and industrial age. Countries around the globe have increasingly been spending more on making, manipulating, managing, and moving bits and bytes of information than on handling the material world's atoms and molecules. This monumental shift from Industrial Age production to that of the Knowledge Age economy[5], which is the use of knowledge to generate tangible and intangible value[6]. In the twenty-first century, routine jobs related to the Industrial Age will continue to decline and knowledge-based jobs will continue to grow both in scope and quantity. It is projected that by 2030, there will be three billion software and robot-based jobs in the world. The Knowledge Age requires a new mix of skills[7] (e.g. professional ways of thinking and complex ways of communications).

The OECD holds that developments in society and the economy require that educational systems equip young people with new skills and competencies which allow them to benefit from the emerging new forms of socialization and to contribute actively to economic development under a system where the main asset is knowledge. While digital technology has impacts on our cognitive development, values, lifestyle and expectations of education, these skills help to reduce these impacts. Compared with those in the Industrial Age, these skills are more compatible with the knowledge economy, the developments in science and technology and demands of society[8]. The knowledge taught in schools should be tailored accordingly or can be searched based on the problems to solve. Students should be able to associate their acquired knowledge to make sense of unfamiliar subjects, and thereby generate knowledge by themselves[9].

Force 3: Scientific and technological development and the information age

Scientific and technological development is an important foundation for economic growth and social development, and enhances national

competitiveness. Hence it is considered one of the core elements of the twenty-first century competencies. The widespread application of computer and Internet technologies has ushered in a new Information Age. New talents and skills are needed in the Information Age which should support collaborators in proposing innovative plans on the basis of information collection, analysis and integration[10]. For instance, Korea has focused on students' own initiatives for personal development. The aim is to lift them above the level of simply being equipped with certain technologies or knowledge to the level of being versatile and innovative. Such students will generate more creative and useful value in the Information Age[11].

Economic and social development

Economic and social development needs to be supported by a talent pool. Higher quality education will help address the challenges arising in the process of development. Thus, economic growth, occupational competencies, demographic changes, multi-culturalism, as well as environment and sustainable development are all socio-economic driving forces for the twenty-first century competencies. While the changing era and transformations in science and technology is a global driving force, these five driving forces are more related to the specific needs and challenges facing regional economic and social development.

Force 4: Economic growth

Education is one of the solutions that can address challenges and problems in economic growth. Firstly, governments have raised the quality of education in order to boost the existing industries in Brazil, the most innovative and competitive enterprises are in aviation, petrochemicals, natural gas, mining, steel, paper-making, brewing and meat processing. The average number of years in education for the labor force in these enterprises is nine, on-job training included. Meanwhile in enterprises that only sell products to the domestic market or lack innovations, the number is fewer than seven. To boost its economy, Brazil must raise the quality of education and thus foster a large pool of skilled workers[12]. Secondly, rapid economic growth requires new skills and competencies among individuals. For instance, the province of Alberta in Canada aspires to shift from relying on natural resources and primary agricultural products to developing products with higher added value in sectors such as bio-science, information technology, and nanotechnology. To make this shift possible[13], creative talents are in the pipeline. Thirdly, there is a universal need for education to solve problems in economic development such as low employment rates, high unemployment rates among the younger generation, poverty, the huge gap between the rich and poor and low levels of economic development.

Despite rapid economic growth within the Asia-Pacific region, the Economic Survey of Asia and The Pacific 2013 reveals undeniable economic challenges. As it shows, the region hosts more than two-thirds of the world's population, with over 800 million people in the region living below the poverty line which is less than 1.25 dollars per day, 563 million considered under-nourished and more than one billion considered to be working in vulnerable employment[14].

Force 5: Occupational competencies

Occupational Competencies and Economic Growth are two closely related driving forces. The development of the society and economy plus the emergence of new types of work require new skills. Low employment rates, unemployment and other social and economic problems demand higher occupational competencies. In the twenty-first century, traditional education models, mostly following the sequence of "schooling, working and retirement", will fade away[15], and people will receive lifelong education from the government, extended to their families, schools and societies. They will receive education from the government at all levels from K-12 to higher education and to continuing education and there will be a never-ending process mixing education and work. Economies are all keen on developing re-education or lifelong on-job education programs to encourage citizens to gain an awareness of lifelong education.

In Russia the occupational education system could not satisfactorily address the issue of talent shortage, and the low-skills of new job seekers brought down the employment rate. Graduates from many institutions of occupational education could neither find jobs nor adapt themselves to modern economic development. The dynamic trends in economic development, stimulation of competition, shrinking opportunities for low-skill or no-skill workers, and the profound structural changes on the job market require frequent on-the-job training to sharpen the workers' skills and improve the citizens' adaptability to a new occupational world[16].

Force 6: Demographic changes

The demographic structure comprises elements such as age, gender, race, nationality, religion, level of education, occupation, income and size of the family unit. As one of the driving forces for the twenty-first century competencies, the main trends in demographic structural change are population aging and sub-replacement fertility (which lead to population declines). These demographic changes disturbed the demographic equilibrium, severely hampering economic growth and productivity. Such trends, for instance, will escalate in Japan in the

next two decades. By 2030, 47 Japanese provinces and prefectures will suffer both population decline and the aging problem. By 2035, over 30 percent of the population in 44 provinces and prefectures in Japan will be over 65 years old. Aging, in turn, will hit the economy. The decrease in working-age population results in the shortage of supply in labor force, defueling the momentum for economic growth. An aging population will also burden the social security system, weighing down healthcare and welfare systems. The issues of aging populations and sub-replacement fertility have also been observed in Canada, Finland, Chinese Taiwan, Singapore and other economies.

Force 7: Multiculturalism

Multiculturalism describes the phenomenon of cultural integration that occurs during the processes of immigration, ethnic integration and religious integration. For instance, the Asia-Pacific region's demographic diversity lies in its multitude of languages, ethnicities, cultures and religions. The region boasts more than 3,600 languages comprising almost 51 percent of languages worldwide. Not only is the Asia-Pacific region home to more than half of the world's population (3.7 billion), it is also home to an estimated 31.5 million international migrants or almost 15 percent of the world stock as of 2010[17]. These examples demonstrate the need for an educational system that can encourage the "discovery of others" in order to promote cultural sensitivity and understanding of different cultures, ethnicities and religions across a multitude of national contexts. It also suggests that rising cross-border mobility necessitates a broad and encompassing education appropriate to the needs of students from varying cultural backgrounds[18].

In Canada, population growth is largely driven by First Nations, the Métis, the Inuit and immigrants. This has posed a challenge to all the provinces and territories. Challenges in literacy and communication unique to First Nations, the Métis and the Inuit will need to be addressed. The growing population of immigrants has placed high pressure on the job market due to a deficit in English language skills, essential skills, Canadian work experience and knowledge of workplace culture necessary to participate fully[19].

Force 8: Environment and sustainable development

This report adopts a general definition of the environment. It refers to the ecological environment. A damaged living environment hinders economic growth. This issue gives rise to the aspiration of achieving sustainable development. Achieving developmental goals while sustaining natural resources for socio-economic growth requires education. Besides the ecological environment, climate conditions, natural disasters, social conflicts and other natural or social factors all fall into the

environmental aspect of mankind. In the Philippines a number of policies have been implemented to include knowledge of climate change and disaster risk reduction in the curriculum[20]. It is also estimated that, globally, 28 million children, or 42 percent of total primary-aged children in armed-conflict affected countries, were out of school as of 2011. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs[21]. The 2010 World Innovation Summit for Education (WISE) was convened in Doha, Qatar, where "Improving Education Systems" was an important item on the agenda. Rich in natural gas, Qatar is one of the wealthiest countries with per capita GDP $70,600 (USD). As the country is keenly aware that energy economy is no permanent solution, building a talent pool for Qatar and the Gulf region is imperative. Equipping citizens with skills of learning, adaptability and innovation ensures the future success of the country.

Educational development

Educational development requires a quality education system and resolving problems in the educational sector. These are also demanded by the formulation of education policies and the setting of education goals. Education quality improvement and equity are the two most widely accepted driving forces.

Force 9: Education quality improvement

Education quality improvement includes: Firstly, a vision to build a modern education system. For example, Australia is working on elevating the educational achievements of all young Australians[22] in order to create a world-class education system; Russia has taken educational modernization as a strategic measure to be implemented in the next ten years when formulating its long-term social and economic development policies. One of the basic goals of educational modernization is to ensure the fundamental role played by education and the quality of a modern educational system that caters to the current and long-term individual, social and national needs.[23]

Secondly, to improve citizens' basic competencies in knowledge and culture, law, self-discipline, moral cultivation and other aspects. For instance, the EU believes that, in contrast to the basic skills (mother tongue, mathematics and science), digital literacy, interdisciplinary competencies (such as citizenship and entrepreneurship) and ICT skills are less attended in traditional education. However, these new competencies are equally important in the future knowledge-based, globalized, and fast-evolving societies. In the National Outline for Medium and Long-term Education Reform and Development (2010-2020),

the Chinese government stated, "Improving the quality of education is the key task for educational reform and development. We should adopt the scientific approach to the quality of education and measure the quality with the sole standard, that is, whether education fosters people's all-round development and prepares them for the needs of society. Our management system and mechanism should be pro-quality-of-education. We should focus educational resources and key tasks of schools on improving the teaching process and the quality of education. [A] national standard quality assurance system should be established."[24]

Force 10: Educational equity

Educational equity depends upon two main factors. The first factor is fairness, suggesting that factors specific to one's personal conditions should not interfere with the potential of academic success. The second important factor is inclusion, which refers to a comprehensive standard that applies to everyone in a certain education system. For example, in India, official documents on education point out that, compared with private schools, public schools suffer higher dropout rates and insufficiently qualified teachers, a situation that needs urgent improvements[25]. Israel has the greatest discrepancy in students' school achievement in the world, with a large number of students (mainly Arabs and Jews from poverty-stricken areas) performing rather poorly[26]. In China, educational inequality has become an important factor that hampers the development of its education sector. Inequality is especially substantial between education in rural and urban areas. Recently, the Chinese government has tried to promote educational equity to help every child meet the national standard on educational quality and thereby letting them have access to quality education.

II. FOCUS OF INTERNATIONAL ORGANIZATIONS AND ECONOMIES ON TEN DRIVING FORCES

Similarities and differences exist in the driving forces identified by the international organizations and economies. To better describe them similarities and differences, this report analyzes the ten driving forces from two perspectives: 1) the levels of focus given to the forces, and 2) the differences in development among the economies.

Levels of focus given to the driving forces

Figure 3 shows the number of organizations or economies that have identified a particular driving force for their twenty-first century

competencies framework. It shows that over half of the 29 international organizations or economies put a focus on six driving forces: Globalization, the Knowledge Age, Scientific and Technological Development and the Information Age, Economic Growth, Occupational Competencies and Education Quality Improvement. This indicates that these driving forces are, to some extent, universal.

Figure 3: Levels of focus in the documents for ten driving forces
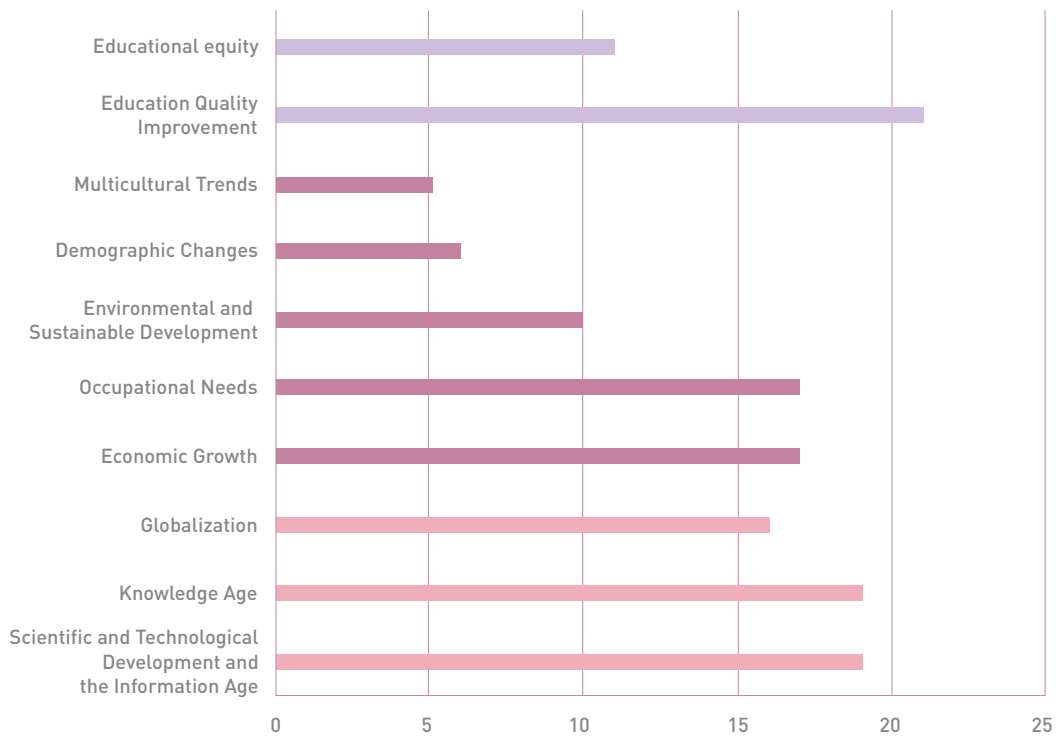
Note. Different categories of driving forces are shown in different colors. The purple bars refer to the group of "Educational Development"; the red ones "Economic and Social Development"; and the pink ones "Change and Transformations in Science and Technology".

Fewer than half of the international organizations or economies focus on Demographical Changes, Multiculturalism, Environment and Sustainable Development, Educational Equity. This would indicate that these four driving forces tend to reflect regional or national demands. For example, population decline, sub-replacement fertility and aging, population density (too high or too low) and other demographic changes mainly prevail in Canada, Finland, Japan and Chinese Taiwan. Some economies face unique environmental challenges. For example, in island states such as Japan, energy and resources crises will significantly slow down their development in the twenty-first century. Environmental and sustainable development are global issues, and the low frequency of this driving force reveals that educational policy-makers have not

yet paid adequate attention in this regard.

Comparing levels of focus given to the driving forces, by income level

Figure 4 compares levels of focus or emphasis given to the ten driving forces, according to two types of economies (15 high-income ones and nine middle-income ones, excluding the five international organizations). Analysis shows similar levels of focus in a number of driving forces, but considerable divergence on four driving forces, such as, globalization.

Figure 4: Comparison of levels of focus on driving forces in economies by income level

Note. Different categories of driving forces are shown in different colors. The purple bars refer to the group of "Educational Development", the red ones "Economic and Social Development", and the pink ones "Change and Transf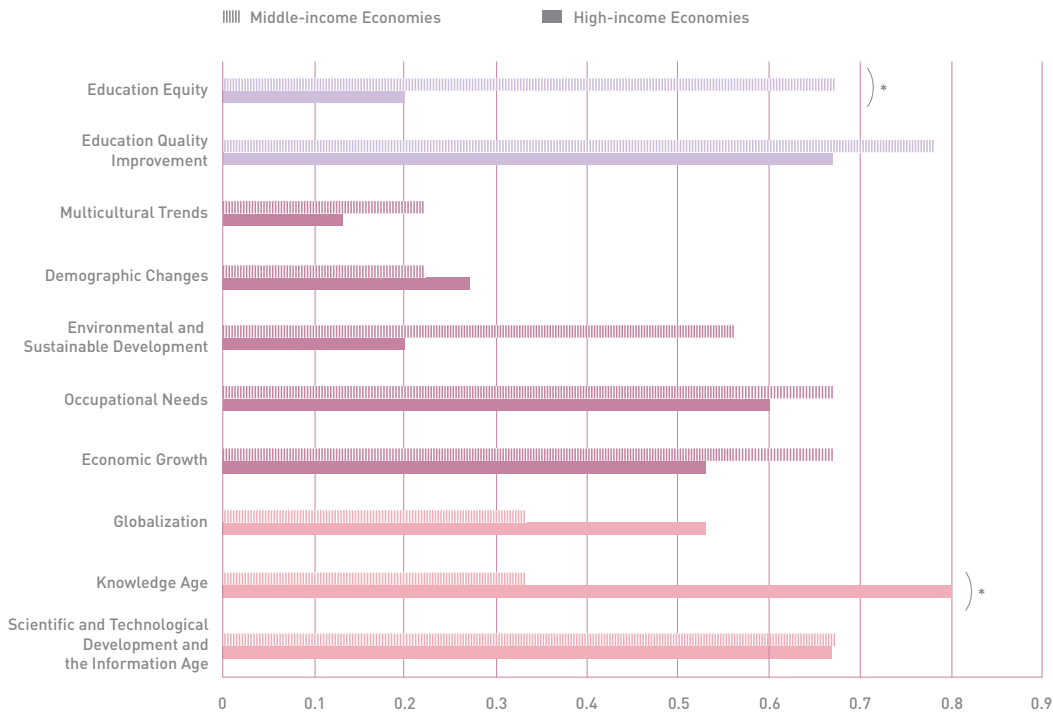ormations in Science and Technology". The x-coordinate represents the level of focus by two types of economies on each driving force; and the value is the ratio of frequencies to the number of economies. For example, of the 15 high-income economies, 12 referred to the driving force the Knowledge Age, thus the quantified level of attention is 12/15=0.8. "*" represents the significance level of P < 0.05.

High-income economies focused more on the driving forces of Globalization and the Knowledge Age. Chi-square tests showed that the concern for the Knowledge Age among the high-income economies was significantly higher than that of the middle-income ones [$X^2(1)$ = 5.23, p=0.03],

indicating that high-income economies were more concerned with the demands of Knowledge Age challenges. This may reflect their post-industrial status. The high-income economies are now pursuing the knowledge economy as a priority; the driving force of the Knowledge Age creates more attention to education reform[27].

In contrast to high-income economies, middle-income economies were more focused on Educational Equity and Environment and Sustainable Development. Chi-square tests showed that concern for Educational Equity from the middle-income economies was significantly higher than that of the high-income ones [$X^2(1) = 5.23$, p=0.03]. This indicates that the middle-income group was more concerned with Educational Equity. In the category of educational development, both types of economies focus on Education Quality Improvement, while some middle-income economies pursue educational equity in a more substantive manner. UNESCO statistics could explain this difference. In 2008 the gross enrollment rate (GER) of pre-primary education was 77 percent in high-income economies, 66 percent in upper-middle-income ones, and 42 percent in lower-middle-income ones[28]. Middle-income economies are facing more severe problems regarding education equity and therefore focus more on this driving force.

III. RECOMMENDATIONS AND STRATEGIES

Policy-making should be founded on a comprehensive, in-depth analysis of the driving forces with a global vision.

The discovery, evaluation, analysis and synthesis of the driving forces will exert huge impact on people's recognition and acceptance of the importance and urgency of an educational system focusing on the twenty-first century competencies. They will also be substantial for garnering strengths and resources from governments, enterprises, media and the public and therefore deserve closer attention from policy-makers. This report assigns the ten driving forces for the twenty-first century competencies to three categories. Globalization, the Knowledge Age, Scientific and Technological Development and the Information Age, Economic Growth, Occupational Competencies and Education Quality Improvement are six universal driving forces that reflect common needs, challenges and pressure facing most economies. Policy makers should pay adequate attention when determining competencies for future citizens. Demographic Changes, Multiculturalism, Environment and Sustainable Development, and Educational Equity are more regional and economy-specific driving forces. Economies of similar income,

cultural backgrounds, or other aspects in common, could draw on the initiatives, efforts and resources of one other. Policy makers should be forward-looking and take initiative, as driving forces such as Demographic Changes and Multiculturalism could evolve into issues at a global scale.

When determining the driving forces, societies should fully consider their levels of socio-economic development, cultural traditions and geographical features.

The greatest commonality lies probably in the diversity and differences among the driving forces. Confronted with different social, cultural and economic realities, economies differ in determining the driving forces. Some economies, with high tech and rich material life, tend to focus on challenges for education brought by transformations such as the Information Age and the Knowledge Economy. Other economies are poor and their people vulnerable to natural disaster or wars; they are more focused on Educational Equity or Environment and Sustainable Development. Such economies need to find and prioritize driving forces based on their own development levels and cultural backgrounds. They should reflect on their realities and goals in education and formulate policies accordingly.

Education policies based on driving forces need to center on the nature and developmental needs of children.

It is noticeable that most of the ten driving forces are socio-economic forces. This indicates that policy makers based their twenty-first century competencies frameworks on socio-economic needs to prepare students for future jobs, technologies and complex social structures. Most of these forces are external challenges and meeting the needs of society rather. They are not addressing the needs of individual students. It should become the cherished goal of all educators to respect their nature and to ensure that every citizen could enjoy health, happiness, dignity and individuality. This is also what the policy makers need to think about thoroughly.

#3

TWENTY-FIRST CENTURY COMPETENCIES AND FRAMEWORKS

#3 TWENTY-FIRST CENTURY COMPETENCIES AND FRAMEWORKS

Education goals vary across international organizations and economies; the components and frameworks of twenty-first century competencies are therefore different. This section initially presents and analyzes several representative frameworks; then categorizes 18 competencies out of 29 competency frameworks into two dimensions, i.e., subject-specific and general competencies. We analyze the frequency of occurrence of each competency in the 29 competency frameworks and compare how high-income economies and middle-income economies differ in this respect. Based on the analysis, we provide several suggestions to policy makers for formulating the competency framework.

I. EXAMPLES OF TWENTY-FIRST CENTURY COMPETENCIES FRAMEWORKS

To meet the needs of diverse development trends, the twenty-first century competencies frameworks are comprehensive. Yet organizations have varying missions and targets; and economies differ developmentally and culturally. Their various frameworks therefore reflect individual goals and objectives. Some, like the OECD[29], aim to help citizens live successful lives and develop well-functioning societies; others, like the EU[30], UNESCO[31] and Chinese Taiwan[32], aim to sharpen citizens' learning skills and promote lifelong learning. Some, like US P21 (of the United States)[33], APEC[34] and Canada[35], aim to cultivate creativity and entrepreneurship and focus on the needs of job market. Others, like Singapore[36], Hong Kong SAR, China[37], Mainland China[38, 39] and South Korea[40,41], emphasize core values and the sense of responsibility. And there are still other economies such as Russia[42] which focus on citizens' daily life and the quality of leisure time.

OECD: Living a successful life and developing a well-functioning society

To help the youth meet the challenging demands, such as rapid technological development, social diversification and the trend towards regionalization and globalization, the OECD started to devise the twenty-first century competencies framework in 1997. After research and discussions by many parties, the report titled Definition and Selection of Competencies: Theoretical and Conceptual Foundations, DeSeCo in short, appeared in 2003, and was published on the official website in 2005. The competencies in this framework were chosen "by careful consideration of the psycho-social prerequisites for a successful life and a well-functioning society"[43].

The OECD 2005 framework is a conceptual framework which divides the competencies into three categories, namely, "using tools interactively", "interacting in heterogeneous groups" and "acting autonomously", which have different foci, but are inter-connected and lay the foundation for key competencies (Table 3). This framework goes beyond traditional taught knowledge and skills, centers around reflectiveness, and combines all the key competencies. The OECD believes that key competencies are those of particular value, that have multiple areas of usefulness and that are needed by everyone. Selection of these competencies should consider their usage in different economic, social and individual contexts, and in certain sectors such as the business sector[44].

Table 3: OECD (2005) key competencies framework

Competency Category	Key Competencies
Using Tools Interactively	A. Use language, symbols and text interactively
	B. Use knowledge and information interactively
	C. Use technology interactively
Interacting in Heterogeneous Groups	A. Relate well to others
	B. Co-operate
	C. Manage and resolve conflicts

Acting Autonomously	A. Act within the big picture
	B. Form and conduct life plans and personal projects
	C. Assert rights, interests, limits and needs

The OECD conducted follow-up research on the development of key competencies in 2009[45], 2013[46] and 2015[47]. Their research projects have different emphases, and yet follow closely the changes of the era and hold that educational systems in the twenty-first century should help students develop skills and competencies suited to individual development and social progress. For instance, its reports of 2009 and 2013 keep a watchful eye on the impact of Information and Communications Technology (ICT) on society and individuals, and point out new competencies required by ICT development. The reports of 2013 and 2015 point to a gap between what the new job market requires and what the job seekers could offer. Therefore, the OECD reminds its members to cultivate the required skills and competencies of young people.

The European community: Developing key competencies for lifelong learning

Key Competencies for Lifelong Learning: A European Reference Framework was published in 2005, providing guidelines and references for the education policies in EU countries, especially regarding curricular reforms. One of its aims was to "support Member States' work in ensuring that by the end of initial education and training, young people have developed the key competences to a level that equips them for adult life and which forms a basis for future learning and working life, and that adults are able to develop and update their key competences throughout their lives"[48].

Those key competencies include:

- Communication in the mother tongue

- Communication in foreign languages

- Mathematical competence and basic competences in science and technology

- Digital competence

- Learning to learn

- Social and civic competences

- Sense of initiative and entrepreneurship

- Cultural awareness and expression

In this framework, each competency is defined as a combination of knowledge, skills and attitudes. The framework points out that fundamental basic skills of language, literacy, numeracy and information and communication technology are the foundation for lifelong learning; the "learning to learn ability" underpins all learning activities; other competencies, including critical thinking, creativity, initiative, problem-solving, risk assessment, decision-taking, and constructive management of feelings are also essential.[49] Its title, goals and content indicate that "learning to learn" is a competency stressed by EU throughout its primary education. This corresponds with its ultimate goal of lifelong learning.

The United States: Preparing young people for twenty-first century employment

In 1990, the US Department of Labor set up a special commission, the Secretary's Commission on Achieving Necessary Skills (SCANS), to identify necessary skills for young people in their careers. What Work Requires of Schools produced by the Department of Labor in 1991, defined five necessary competencies of twenty-first century workers[50]. In 2002 the US officially launched research on twenty-first century skills and established the Partnership for 21st Century Skills (P21) to determine the required skills for young people in the new millennium. And this framework has gained worldwide attention and plays an influential role in the development of competencies frameworks.

The relations among the above-mentioned skills (the outer arch), key subjects and twenty-first century themes (the green arch) and the support systems (the bottom of the figure) are represented in Figure 5. The three parts are a blending of specific skills, content knowledge, expertise and literacy. They describe the necessary skills, knowledge and expertise that students must master in their work and life. The development of each skill requires the support be based on the acquisition of key subjects and themes represented by the inner arch. They are the underpinnings of the twenty-first century skills.

Moreover, it is worth noting that two features stand out in this framework: the combination of process and results; and its emphasis on the role of support systems in the competencies framework.

Figure 5: US P21: A framework for 21st century student outcomes and support systems

LEARNING AND SKILLS — 4CS
Critical thinking • Communication
Collaboration • Creativity

LIFE AND CAREER SKILLS

KEY SUBJECTS — 3RS AND 21ST CENTURY THEMES

INFORMATION, MEDIA, & TECHNOLOGY SKILLS

Standards & assessments

Curriculum & Instruction

Professional Development

Learning Environments
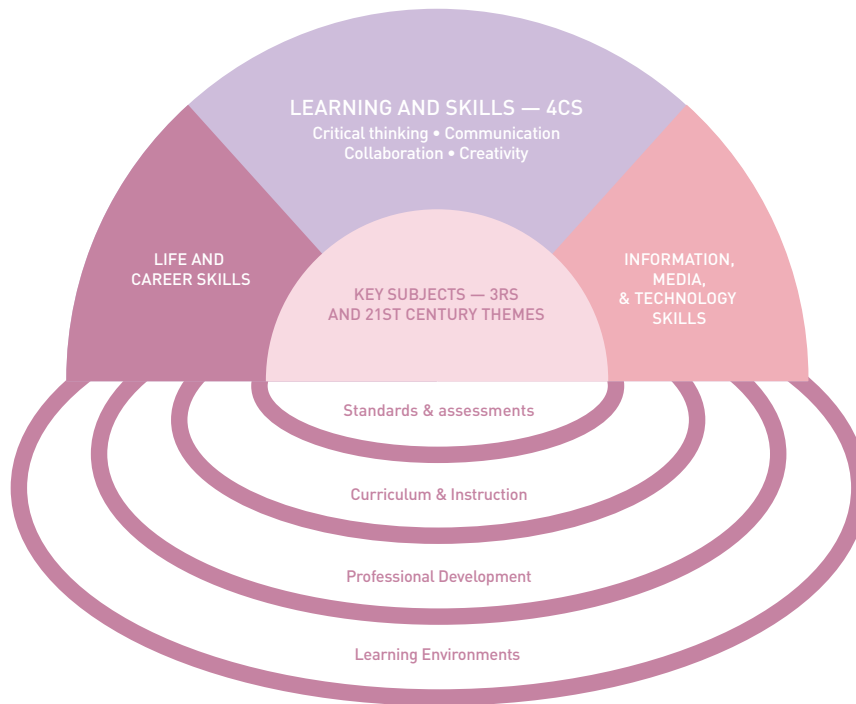
Note. Retrieved from The Partnership for 21st Century Skills. (2016). Framework for 21st Century Learning. Retrieved May. 28, 2016, from http://www.p21.org/storage/documents/docs/P21_framework_0116.pdf

Asia: Frameworks focusing on core values

Asian economies share similarities in their historic, geographical, economic and cultural backgrounds. Their competency frameworks are similar in putting a stress on values and attitudes. The cases of Singapore, Hong Kong SAR, China and Mainland China are provided as follows.

The Singaporean vision of "Thinking Schools and Learning Nation" (TSLN) aimed to achieve four outcomes, namely to cultivating the confident person, the self-directed learner, the active contributor, and the concerned citizen. As Figure 6 shows, from the inner core to the outer circle, the framework contains three layers: Core Values; Social and Emotional Competencies; and the emerging twenty-first Century

Competencies. At the center of the framework are the core values, including respect, integrity, care, resilience, harmony, and responsibility --key elements of the framework that determine what kinds of communication skills and EQ capabilities (red circle) and then what new twenty-first century skills (orange circle) should be developed for students to achieve the four outcomes.

Figure 6: Singapore's framework for 21st century competencies and student outcomes
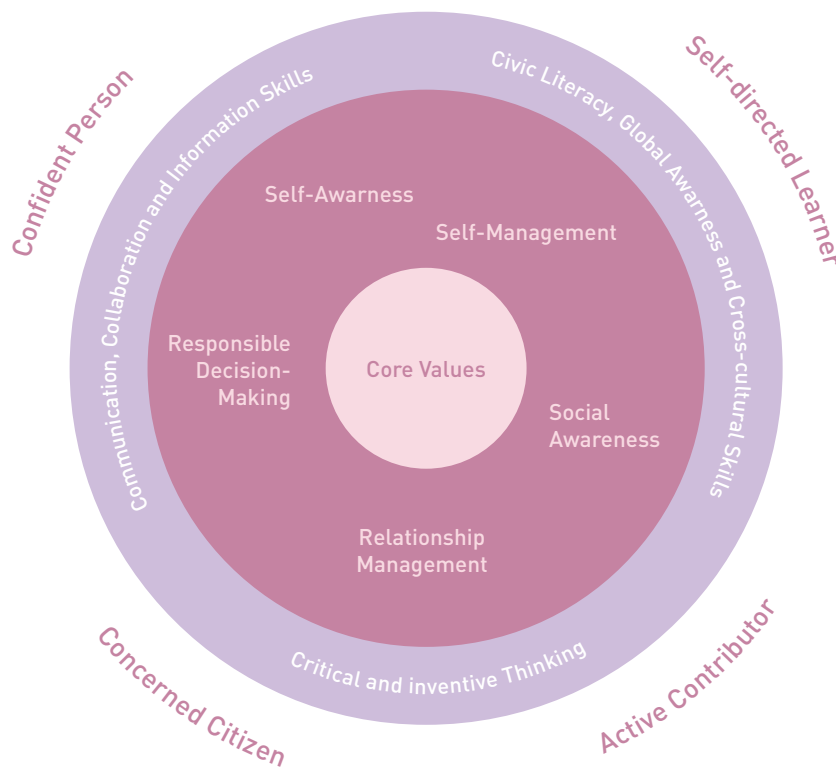
Note. Retrieved from Singapore Ministry of Education. (2015). 21st century competencies. Retrieved May 28, 2016, from http://www.moe.gov.sg/education/education-system/21st-century-competencies

Learning to Learn: The Way Forward in Curriculum of Hong Kong SAR, China is composed of eight key learning areas, nine generic skills and a series of values[51]. Values and attitudes are the unique part of Hong Kong's twenty-first century competencies framework. Values are the foundation of attitudes and beliefs, which in turn affect the way of life and human behavior. The values can be further grouped into core values and sustaining values. The core values are universal values respected in all human societies, while the sustaining values help maintain the core values.[52] Values and attitudes are suggested to be

incorporated into school education systems; these include 11 individual core values, such as the sanctity of life, truth and aesthetics etc.; 14 individual sustaining values, such as self-esteem, self-reflection and self-discipline etc.; 12 social core values, such as equality, kindness and benevolence etc.; 13 social sustaining values such as diversity, legal procedure and democracy etc.; and 18 attitudes such as being ready to participate, critical thinking and creativity etc.[53].

Mainland China's 2001 Curriculum Reform of Basic Education stressed students' attitudes and values. Its goals were categorized in three dimensions: knowledge and skills; process and method; affects, attitudes and values. They are reflected in the curriculum standard as well as the teaching and evaluation of all subjects[54]. In 2014, a new round of curriculum reform was initiated with "strengthening morality education and cultivating talents" as the main task. In its guidelines, the China Ministry of Education requires that the whole process of education incorporate and promote the core socialist values, i.e., prosperity, democracy, civility, harmony, freedom, equality, justice, the rule of law, patriotism, dedication, integrity and friendship. The MOE is organizing research on core competencies for each stage of education and identifying essential characteristics and key abilities for students to adapt to lifelong development and social demands. These core competencies emphasize individual development, social compassion, and national pride, encouraging autonomous development, cooperation and creative practices. [55]

Russia: Improving people's daily lives and cultural recreation

The Russian Education Modernization Strategy[56] published in 2001 by the Ministry of Education of Russia, initiated its educational reform, shifting from knowledge-based to competency-based education. The key competencies of Russia are categorized into five dimensions: cognition, everyday life, cultural recreation, civil society and social labor. Cognitive competency refers mainly to the ability to obtain information and knowledge; everyday life competency relates to personal health and family life; cultural recreation competency involves the ability to enrich personal cultural life in spare time; citizenship competency helps students adapt to their roles as citizens, voters and consumers; and social labor competency teaches students to analyze the labor market, evaluate their own job opportunities, deal with labor relations in an ethical manner and manage themselves.[57]

The most distinctive feature of the Russian framework for twenty-first century competencies is that it includes competencies in quality and recreation of life. Individual health, family life and proper recreational activity are highly valued by Russians, a tradition rooted in the country's traditional educational concepts. The artistic and cultural environment in Russia and the supplementary education system enable the cultivation of these competencies for its citizens.

II. LEVELS OF EMPHASIS GIVEN TO THE COMPETENCIES

Each framework consists of competencies organized and expressed in distinctive ways. To compare the competencies and analyze the frequency of their occurrence in various frameworks, we have consolidated competencies from 29 competency frameworks into 18 competencies for the present study. The level of emphasis or focus for each of them given in the frameworks has been analyzed.

Consolidating the competencies

We have identified 18 competencies from the 29 competency frameworks by consolidating competencies of similar meaning and at the same level of the framework. These competencies, which can be grouped into two dimensions (subject-specific and general competencies), reflect how policy-makers from different economies or organizations understand and value the competencies.

Table 4: Categorization of 18 competencies

Dimension	Competency
Subject-specific Competencies	**Competencies in basic subjects:** language, mathematics, science and technology, humanities, art, sports and health **Competencies in new subjects:** information, environment and finance

Dimension	Competency
General Competencies	**Higher-order Cognition:** critical thinking, creativity and problem solving, learning skills and lifelong learning
	Personal Development: self-perception and self-control, life planning and well-being
	Social Development: communication and collaboration; leadership; cross-culture; civic responsibility and social participation

It should be noted that although the 18 competencies are identified according to what we expect for a whole person for the twenty-first century, the whole-person development is not simply a total of these competencies. They are not mutually exclusive; instead, they overlap or interlock. For example, the life planning and well-being competency shares essential skills, such as personal cultivation and development with the humanistic and artistic competency, and the inter-personal communication abilities such as the "communication and collaboration competency".

Some other terms can also be found in the competency frameworks provided by organizations and economies, such as morality, ethics, responsibility, fairness, empathy, sincerity, respect, tolerance, and perseverance. These terms concern attitudes or values which are addressed differently in various frameworks. The OECD (2009) framework, for example, chooses ethics and social impact as one of its three competency dimensions; and value is singled out and holds a significant position in the frameworks of Singapore, Hong Kong SAR, China and South Korea, while most other frameworks include it in other competencies. Considering that the meaning of competency is essentially comprehensive, involving skills, attitudes and knowledge, we blend affects, attitudes and value-related factors into competencies in which they fit instead of singling them out as individual competencies.

Emphasis given to each competency across the 29 frameworks

The emphasis given or importance of each competency is measured by the frequency of occurrence of the 18 competencies. It represents

the attention each competency received across the world. For instance, language competence is included in 14 frameworks. Several features can be identified.

Figure 7: Frequency of occurrence in the 29 frameworks for each competency
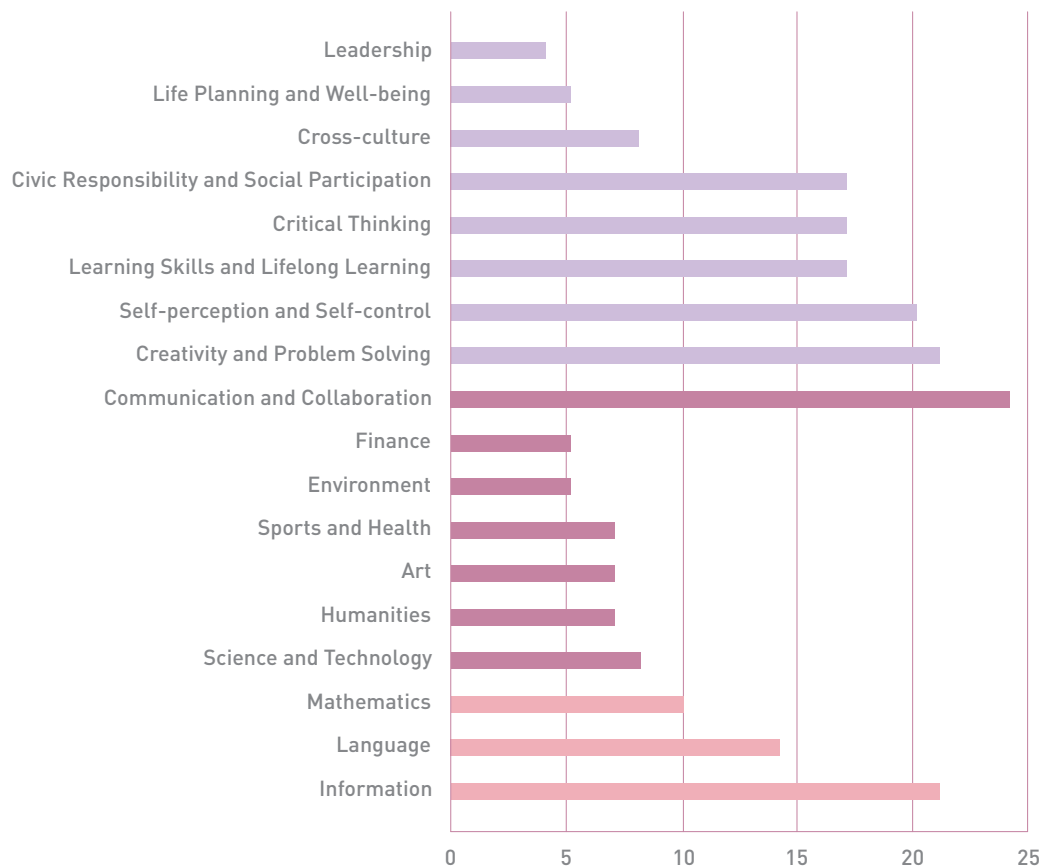
Most of the competencies have received broad attention, suggesting that they are focused on developing the all-round individual. The figure shows that 18 competencies have received universal attention, and notably, nine competencies, including language, numeracy, science and technology, critical thinking, creativity and problem solving competencies, are included in a third of the frameworks. Instead of confining to specific fields related to critical crises or challenges, the competencies have a diversified and comprehensive scope. Moreover, competencies of non-cognitive dimensions, such as the personal dimension and the

social dimension, are more valued. Therefore, we conclude that training an all-round individual is becoming a new trend in global education.

People pay special attention to competencies related to significant transformations in the world. The current age of science, technology and information requires citizens to develop a higher level of information literacy; the age of knowledge and the creative economy demand critical thinking skills, innovation capabilities, and problem-solving skills; and the increasingly intensified process of globalization necessitates more effective communication and collaboration skills. Such competencies have attracted the interest of organizations and economies, as they are incorporated in over 50 percent of the frameworks.

Financial competence and leadership are new highlights in education. Although the attention drawn to these two competencies is still low and has not yet been universally included in across the competency frameworks, the interest in them has increased in the field of education. Take financial competence, for example. Consumer education research and initiatives emerged in the early twentieth century, which focuses on the money management of twelfth-grade students (cf. Jelly, 1958[58]). However, such a notion had long been neglected until the twenty-first century. The US P21 framework selects financial literacy, economic literacy, business literacy and entrepreneurship as leading interdisciplinary themes for the twenty-first century; UNESCO regards financial literacy as the continuation of numeracy; other economies have also required their citizens to foster business awareness[59]. This shows that financial competence is a noteworthy constituent of the competencies today.

Attention paid to competencies concerning individual happiness and global sustainable development is limited. Competencies in humanities, art, sports and health in the subject-specific dimension and life planning and well-being in the general dimension are closely related to individual happiness. Yet, people have not shown much interest in these competencies, with the evidence that only seven frameworks incorporate the competencies in humanities, art, sports and health and five frameworks include the life planning and well-being competency. Besides, sustainable development, locally and globally, is essential to human survival and it calls the efforts of all human beings. However, environmental competence, a competency directly related to it, has also been widely overlooked. The reasons for this require further analysis.

Comparing Levels of emphasis for competencies, by income level

The vertical axis in Figure 8 shows the levels of attention or emphasis given to the 18 competencies in the frameworks according to two groupings of economies (15 high-income economies and nine middle-income economies). The frequency of occurrence of the competency in the framework is divided by the number of economies that fall into this category.

Figure 8: Levels of emphasis for competencies in economies, by income level

Note. Different categories of competencies are shown in different colors. The purple bars refer to the group of "General Competencies", and the red ones "Subject-specific Competencies". "*" represents the sig - nificance level of P < 0.05. "**" represents the significance level of P < 0.01.

The differences between two groups of economies are summarized as follows. High-income economies' competency frameworks cover a wider range of competencies, including financial competency, life planning and well-being, leadership, etc. This may be attributed to their more advanced educational systems. The development history of the twenty-first century competencies frameworks reinforces this argument; twenty-first century competencies first received attention from economies with strong educational systems and gradually rolled out to other parts of the world. This explains why the frameworks in high-income economies cover more competencies and pay greater attention to most of them.

The result of the Chi-square test showed that the concern for learning to learn and life-long learning competency from middle-income economies was significantly higher than that from high-income economies [X^2 (1) = 8.64, p=0.007]. It indicates that the former group pays more attention to competencies. The high-income economies, meanwhile, show more interest in information, financial competence, critical thinking and creativity and problem solving competence. Such a contrast reflects exactly the specific concerns of different economies: the high-income economies are concerned about challenges of the knowledge age and globalization, and the other groups are concerned about other aspects of economic development such as industrial growth.

Among the general competencies, self-perception and self-control and life planning and well-being competencies draw more attention from high-income economies. The result of the Chi-square test showed that the concern for self-perception and self-control competency from high-income economies was significantly higher than that of middle-income economies [X^2 (1) = 7.20, p=0.02]. We suggest this is likely because the high-income economies are at a more sophisticated stage of development where these competencies are more frequently valued.

Both groups are focused on local or regional development, and yet the high-income ones pay higher attention to the global trends, although there is no significant difference in the domain of social competencies between the two groups. Both groups give attention to communication and collaboration competency and civic responsibility and social participation competency–competencies related to civic and social life, or responsibilities for and engagement in national and regional development. The high-income economies pay more attention to leadership and cross-cultural competency and this can be ascribed to the role they play in international affairs. It might indicate that they look forward to more extensive international communication and cooperation, and hope to continue their leadership in the world.

III. RECOMMENDATIONS AND STRATEGIES

The 18 key competencies from 29 competency frameworks worldwide take stock of the current research results in the field of competencies for twenty-first century citizens. They provide much food for thought to the policy-makers.

Competencies should keep up with the time, international trends, and regional demands, and be based on local educational goals.

Firstly, driving forces are fundamental to policy-making and competency selection. The more clearly a driving force is identified, the more accurate a competency will be defined in the framework. For example, the ICT competency clearly responds to the needs of the Information Age. However, some macro-level driving forces such as economic development, occupational demands, demographic changes, and educational equity could not easily pair up with any specific competency but a group of them.

Secondly, focus should be put on future jobs, occupational development, and individual happiness. For example, competencies related to daily life and cultural recreation are incorporated in the Russian framework, and competencies of looking after oneself, managing activities, and safety in the Finnish one. This is worthy of the attention from the policy-makers in such an era with an emphasis on humanism.

Thirdly, we should keep up with new trends and requirements of the international education field when developing competency frameworks. Financial, leadership, and cross-cultural competencies are not frequently mentioned in the 29 frameworks, but they reflect new requirements of global-scale innovation and competition and education quality improvement. Environmental awareness as a competency is also gaining global attention. For example, the US P21 has included environmental competency into twenty-first century themes, and Finland emphasizes individual responsibility for environment, health, and sustainability, hoping to enhance students' awareness of contributing to environmental protection and human health.

Interpret the meaning of competencies so as to establish a hierarchical and systematic network within and among competencies

Overall competency involves analyses and interpretations of each competency to decide whether and how well we might fulfill our competency education goals.

In many areas, the meaning of some competencies that we are familiar with has changed substantially. In recent years, international education reform began to focus on emerging competencies, but the interpretation of their meaning is neither clear enough nor always appropriate. We should consider these issues when developing competency frameworks. For example, in the past, science competence only focused on sciences. In 1980s, the emerging Science, Technology, Society (STS) education brought attention to technologies. Currently, STEM and STEAM education take place of STS education and focus more on technologies, projects, mathematics, and arts integration. Such development plus emphasis on scientific exploration is enriching the meaning of science competency.

Therefore, policy makers should focus on two aspects. First, each competency should be clearly defined from perspectives such as knowledge, attitudes, and skills and a layered formative model of meaning might be created. Second, they should clarify relations among competencies and establish a network, which should focus on cultivating an all-round individual, not just piling up competencies.

The framework and education practice of twenty-first century competencies should feature lifelong learning.

The development of twenty-first century competencies transcends different phases of education. The development spans different levels and age groups. It needs coherent education and years of accumulation in a progressive way. (e.g. the World Bank framework). Different stages have different foci. Early childhood education focuses on basic cognitive and social skills, followed by more focus on higher cognitive abilities and problem-solving abilities[60]. The twenty-first century competencies education should respond to different foci of different age groups by providing certain levels of competencies. In this way, an individual is educated throughout the whole lifetime. For instance, the World Bank framework divides a person's life from birth to the end of career into several phases: pre-school, school phase, young worker phase and mature worker phase. Competency goals for different phases have been set correspondingly[62].

Time-tested competencies are also important in addition to the emerging ones.

We live in a fast-evolving world. Scientific and technological advances urge us to acquire new skills; economic development pushes us to be more sensitive to economic and financial issues; cultural transitions require us to adapt to new lifestyles. With changing societies come

different educational goals, as well as new competencies tailored for that time. However, we should reflect on one issue: Are there any educational goals that have not changed throughout the history? If yes, what are they, should they be integrated into the twenty-first century competencies framework, and what is the relationship between them and contemporary demands?

#4

INTEGRATING TWENTY-FIRST CENTURY COMPETENCIES INTO EDUCATION SYSTEMS

#4 INTEGRATING TWENTY-FIRST CENTURY COMPETENCIES INTO EDUCATION SYSTEMS

Fostering twenty-first century competencies is a step-by-step process which can only be realized through sophisticated multi-layered education systems. As the framework of twenty-first century competencies was not put forward until recently, most regions in the world still remain at the stage of framework building rather than real implementation. Moreover, the impact of implementation on students takes time to emerge. It is premature to make any judgments. Some countries and regions may have already experimented with the framework, but their experience has not been consolidated into reports or papers. Therefore, this section will not attempt to make general comments on the educational practices for twenty-first century competencies. Instead, examples from various countries and regions are provided to illustrate ways of developing the competencies.

I. CURRICULUM FOR TWENTY-FIRST CENTURY COMPETENCIES

The K-12 curriculum is a key tool for countries and regions to achieve their educational objectives. Integrating twenty-first century competencies into this curriculum will be helpful for future generations to acquire them. Based on the characteristics of individual educational systems, some economies have gradually introduced a few twenty-first century competencies into their national curriculum and have been teaching students and developing teaching resources following a revised curriculum incorporating cross-disciplinary themes.

Integrating the competencies into existing curricula

An effective way to promote educational practices for twenty-first century competencies is to integrate the competencies fully into existing K-12 curriculum to create a new course framework that advances the idea of citizen competency. Since the current curricula of most economies are comprised of various subjects, we should try to assimilate the twenty-first century competencies into the teaching of these subjects, so that competencies can be fostered as the subjects undergo reforms.

Atlantic Canada has integrated a number of twenty-first century competencies as Essential Graduation Learning into their Grade 1 to Grade 12 courses. The final product of this reform is the Atlantic Canada Curriculum Outcomes Framework, into which different competencies could be integrated with clear targets based on the subjects in which students are studying. For example, communication skills could be developed as they study mathematics, language, art and science.[62]

When designing its national curriculum in 2009, Australia stated that the curriculum should help students to acquire seven general capabilities. The country supplemented this move with several policies in 2010 and 2011 to ensure the effective and coherent inclusion of the general capabilities into the Australian Curriculum.[63] This case shows that the development of twenty-first century competencies may not require a brand new curriculum; improvements on the existing ones will do.

The United Kingdom requires students at all stages of schooling to learn, practice, develop and refine a number of skills. Some of these skills are subject-specific (art, painting and design); others are involved in several subjects (the research capability needed in science, history and geography). Besides, some skills are inter-disciplinary, such as communication skills and creative thinking. These inter-disciplinary skills are also included in the National Curriculum.[64, 65]

In Brazil, developing certain skills and competencies has become the basic principle of the national curriculum. For example, Brazil's curricular structure of middle schools is organized in four areas: language, natural sciences, mathematics, and human sciences. The country has identified several skills related to the four areas as learning objectives for all students. Course design and learning activities are also carried out to achieve of these objectives. [66]

Mainland China has declared that fostering core competencies in students will be the prime goal in the upcoming high school curriculum reform. In this round of reform, the "core competencies" will be integrated into the national curricula. [67]

Developing interdisciplinary themes

Selecting and developing interdisciplinary themes targeting twenty-first century competencies based on real-world scenarios.

The primary goal of education is not to enable students to do well in school, but to help them do well in the lives they lead outside of the school. The framework of twenty-first century competencies was conceived exactly to cultivate capabilities that may benefit students throughout the rest of their lives. Developing such competencies requires students to apply knowledge and skills to solve real-life problems rather than acquiring knowledge of a particular subject.[68] In contrast to subject-based knowledge, inter-disciplinary competencies are more applicable to real-world situations. The design of curriculum and the selection of teaching materials should be considered from both disciplinary and interdisciplinary perspectives. Effective interdisciplinary programs must use both disciplinary and interdisciplinary experiences for students in the curriculum. Interdisciplinary studies can also take advantage of opportunities to work with partners who are able to offer and support enriched learning experiences and opportunities for young people's wider involvement in society.[69] That is why in the educational practices for twenty-first century competencies, establishing interdisciplinary themes have become a strategy extensively adopted in all economies.

In the Curriculum for Excellence project launched in 2010, Scotland states that "Interdisciplinary learning is a planned approach to learning which uses links across different subjects or disciplines to enhance learning". To achieve this goal, Curriculum for Excellence has chosen eight areas, namely expressive arts, health and well-being, languages, mathematics, religious and moral education, sciences, social studies and technologies, as its foundations, and has set three interdisciplinary themes - learning for sustainability, global citizenship and enterprise in education. Scotland also says there should be a balance of interdisciplinary learning and learning within the subject areas and disciplines across a term, year and phase. Individual schools and establishments are best placed to decide what the right balance is for them as they respond to their context and to the needs of their learners.[70]

Associating interdisciplinary themes with major regional issues or events

Major local problems and events provide real-world scenarios for learning. Selecting them as interdisciplinary themes can spark students' interest in learning. Teaching activities designed on the basis of such themes are also more comprehensive, capable of developing more types of competencies.

The Philippines' National Curriculum provides an example. It includes environmental issues and climate change as interdisciplinary themes. The Philippines' Climate Change Act of 2010 states that in both primary and secondary education, the theme of climate change should be integrated into both natural science and social science (e.g. history) subjects. Moreover, the 2009 Republic Act and the 2007 Department of Education Order emphasize the integration of Disaster Risk Reduction (DRR) concepts into education, and encourage teachers in different learning areas to amalgamate these concepts into their teaching. The aim is to equip students with the knowledge and skills to become responsible citizens through these interdisciplinary courses.[71]

This is also reflected in Mainland China's curriculum reform. In 2001 the Ministry of Education of China published the Guideline for Basic Education Curriculum Reform, making Integrated Practice Activity a compulsory course for school education from primary school to senior high school. In this course, students could develop their awareness of research and innovation and develop their abilities of knowledge utilization in order to tackle real-life problems. The sessions would also bring students closer to the society and enhance their sense of social responsibility.[72]

STEM has been universally accepted as interdisciplinary themes worldwide.

STEM (Science, Technology, Engineering and Mathematics) and STEAM (Science, Technology, Engineering, Art and Mathematics) have become the primary themes for interdisciplinary courses in various nations and regions. STEM- and STEAM-based curricula provides students with interdisciplinary learning experience between the school subjects of science, technology, engineering, arts and mathematics. In the US, the Department of Education (DOE) has set up the Committee on STEM Education (CoSTEM) and in 2013 DOE published the Federal Science, Technology, Engineering, and Mathematics (STEM) Education Five-Year Strategic Plan to promote STEM education on the federal level. [73]

STEAM disciplines are also important to the South Korean National Curriculum. The Ministry of Education, Science and Technology (MEST) and Korea Foundation for the Advancement of Science and Creativity (KOFAC) agreed that the integrative approach in STEAM disciplines is critical to restructuring school education. The 2009 revised National Science Curriculum began to express the importance of the ideas of integration and convergence for STEAM education, as it held that the implementation of STEAM education in Korea may enhance science, technology, engineering, arts and mathematics education. [74]

Entrepreneurship education is booming.

Some economies have been developing an interest in entrepreneurship-related interdisciplinary themes; and they are jointly meeting the objectives of entrepreneurship education at various levels and in different fields. While entrepreneurship education at primary level is generally addressed by social sciences and involves mathematics, natural sciences and technology in some ways, at secondary level, it is mainly integrated into economics, business studies and careers education. In 2003 Singapore stressed the concept of entrepreneurship and introduced the Entrepreneurship Immersion Program with an aim to foster such spirit among Singaporean students.[75]

In 2015, after nearly a decade of unfettered development, the 'maker' movement in China finally gained attention at the state level. In June, 2015, the Chinese State Council published the Opinions on Policies and Measures Advancing the Mass Entrepreneurship and Innovation, deciding to incorporate creativity and innovation into national strategies. This move soon started a craze for maker education. Many schools and off-campus institutions have launched maker training programs and opened maker-spaces, providing students with the environment, resources and opportunities to cultivate their innovation capabilities.

Developing teaching resources

Cultivating twenty-first century competencies, either by incorporating them into K-12 curriculum or by interdisciplinary education, demands compatible teaching resources.

Textbooks are important resources to promote twenty-first century competencies. To better advance the curriculum reform which will begin in 2016, Chinese Taiwan redesigned its textbooks to achieve the new teaching objectives that focus on both student general knowledge and learning process and performance. The aim is to cultivate students'

interest in learning and train them on how to learn so that they all stand a chance of achieving their learning goals. Moreover, the teaching materials should be able to link different learning phases seamlessly together and should be thought-provoking enough to enable students to solve problems with their acquired knowledge. Materials should also be inspirational and creative, and provide the opportunity for students to observe, explore, discuss, create, and present.[76]

US P21 has conducted research in many aspects, including curriculum and teaching, learning environment, and educational technologies, and have published their findings. Educators, policymakers, parents, communities and even students have benefited from its work.[77] The P21 has also provided a number of research reports which may serve as teaching materials for twenty-first century competencies education. For example, to help educators and people interested in education understand the interaction between twenty-first century competencies with the curriculum, P21 published a research report which addressed the relation between Common Core State Standards and twenty-first century competencies, and explained that the 3Rs (core academic content mastery, namely Reading, wRiting and aRithmetic) and the 4Cs (critical thinking and problem solving, collaboration, communication and creativity and innovation), components of the twenty-first century competencies framework, had already been included in curricula as basic requirements for all students, not as challenging standards just for the elites. [78]

Table 5: The relation between common core state standards and 21st century competencies

P21 Framework Element	CCSS ELA College and Career Ready Definition
Core Subjects	Build strong content knowledge
Critical Thinking and Problem Solving	Respond to the varying demands of audience, task, purpose, and discipline
Communication	Comprehend as well as critique

P21 Framework Element	CCSS ELA College and Career Ready Definition
Information Literacy	Value evidence
Self Direction	Demonstrate independence
Global Awareness	Come to understand other perspectives and cultures
Information, Media and Technology Skills	Use technology and digital media strategically and capably

Moreover, the US National Research Council (NRC) also published a research report discussing the relationship between the twenty-first century competencies and two national curriculum standards: the Common Core State Standards and A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas in its new round of curriculum reform.[79] These research reports are important teaching materials that help educators or relevant stakeholders to understand how twenty-first century competencies are integrated into the new curriculum and how interdisciplinary education can foster these competencies among students.

II. TEACHING AND LEARNING TWENTY-FIRST CENTURY COMPETENCIES

The development of the competencies transforms teaching and learning methods. Effective approaches include student-centeredness, independent learning or problem/project-based learning.

Student-centered learning

The student-centered learning philosophy motivates students, satisfies their various needs and offers help for the development of related competencies.

Influenced by research results about how students learn, education practitioners have become increasingly aware that effective learning, especially for twenty-first century competencies, occurs when students are motivated and can apply their prior understanding and life experiences.[80] The theory of multiple intelligences and other theories

suggest that as students develop twenty-first century competencies, they may exhibit different strengths and capabilities. The student-centered learning philosophy can meet various needs of students.

Some Canadian schools have improved their way of teaching. Teachers activate students' curiosity and creativity by discussing questions that matter to them, so that they may become motivated and then learn as they understand. C21, a Canadian organization for curriculum design, is committed to advancing student-centered teaching and providing students with opportunities to learn actively and effectively. Such a change in teaching philosophy requires teachers to be able to kindle students' interest with the help of modern technologies so that students may start purposeful exploration.[81]

Russia has also set out requirements about teaching philosophy. First, teachers are no longer mere lecturers of knowledge; instead, they should be the ones who activate students' creativity and independent learning capacity, who create inspirational learning environments and organize activities, so that every student can present their unique aptitudes and pursuits. Second, core competencies are actually a composite of various problem-solving skills. Teachers should lead students to acquire a general capability which may prepare them for any problem in their future work, personal and social lives. With this capability, students can find solutions to new problems by harnessing their prior experience of tackling similar ones.[82]

Problem- or project-based learning (PBL)

PBL is an important strategy to develop the student-centered teaching philosophy, train active learners, and cultivate problem-solving skills.

Problem-based learning is an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem. Project-based learning provides valid instructional strategies to promote active learning and engage the learners in higher-order thinking such as analysis and synthesis. Within a project-based learning process, learners are usually provided with specifications for a desired end product (build a rocket, design a website, etc.). Both learning approaches are similar to each other in that the learning activities are organized around achieving a shared goal (project).[83] Under teacher guidance, students can acquire and apply the core concepts as they try to solve problems and carry out projects.

Problem/Project-based learning, also known as PBL, has been widely acknowledged in the twenty-first century supported by relevant research. Studies have found that: 1) students learn more deeply when they can apply classroom-gathered knowledge to real-world problems, and when they take part in projects that require sustained engagement and collaboration; 2) active and collaborative learning practices have a more significant impact on student performance than any other variable, including student background and prior achievement; 3) students are most successful when they are taught how to learn as well as what to learn.[84]

PBL has been widely applied to the study of many disciplines, science education in particular. Questions and problems are the foundations for the two most powerful approaches humankind has developed for gaining new knowledge and creating new ways of living: science and engineering. [85] Therefore, asking students to explore answers or solutions to scientific questions or engineering problems that actually exist is an important method for science and engineering to contribute to the development of twenty-first century competencies. Such a method has already been adopted by the Next Generation Science Standards as a main strategy for teaching and learning. [86]

III. ASSESSMENT OF THE COMPETENCIES

The development of students' twenty-first century competencies through related curricula and education needs to be measured and evaluated through education assessment, which could provide useful feedback and suggestions for further competencies education.

Formative assessment

When developing competencies, it is essential for both teachers and pupils to learn about their progress and adapt their strategies. Formative assessment, as a tool to promote further learning, could provide timely feedback. "It is not an instrument or an event, but a collection of practices with a common feature: they all lead to some action that improves learning".[87]

Student profile for a timely, continuous, and complete performance record

France advocates a complete record of students' performance starting from elementary schools in the Personal Competence Handbook and has formulated detailed rules for the categorization, methodology, and

assessment standards. Assessments in the Handbook is divided into three stages. The first stage (till Grade 2) only focuses on French, mathematics, and social and civic literacy. The second stage (Grade 3 to Grade 5) focuses on literacy in all of the seven aspects. The third stage (Grade 6 to secondary school graduation) is completed step by step during the whole period, and all the teachers take part in the assessment of students' literacy in all the seven aspects. The Handbook enables teachers to follow their students' progress and ensure the development of their capabilities. At the same time, it serves as a platform for communication with parents. If one particular student has difficulty in the learning process, the teachers will provide timely assistance, for instance, a change in teaching method, supplementary activities. The Handbook will be turned over to the statutory guardians of the students upon their graduation. [88]

In Bulgaria, since 2009, at the end of each year of primary and secondary education, the class teacher gives students a personal profile which presents an assessment of their participation in out-of-school activities (e.g. projects, conferences, competitions, Olympiads, etc.). Upon completion of primary and secondary education, a more comprehensive personal profile is an integral part of school leaving certificates.[89]

In 2004, Requirement of Improving Comprehensive Qualities of Senior High School Students was issued by the Ministry of Education in Mainland China. The publication stated that the purpose of comprehensive competencies assessments was to observe, record and analyze the development of a student in a comprehensive manner. Such assessment was critical for schools to monitor and evaluate the development of each student's character. It was also an important policy to promote education for all-round development. Teachers needed to teach students how to record activities so as to demonstrate their understanding, particularly through the collection of materials and evidence gathering. At the end of each semester, teachers taught students to collect and select records of representative activities as well as other relevant materials. [90]

Developing assessment tools for specific competence

Formative assessment has gained much attention and been practiced in many countries and regions. Before conducting such assessment, we should have assessment tools customized for each competency. For instance, in Sweden, social studies teachers are responsible for the development of students' civic competences. The National Agency for Education has developed a set of six tests for school years seven

through nine to support them in carrying out formative assessment of students' understanding of democratic principles.5

In Austria, in 2011, the Center for Citizenship Education published a brochure dealing with the question of assessing young people's competences in their ability and willingness to find solutions to problems independently, decision-making skills, and conceptual thinking. The publication provided practical lessons and diagnostic exercises which helped teachers to establish students' existing abilities in these areas. [92]

Standard examination or education monitoring

Besides formative assessment, any economy hoping to develop competent twenty-first century skills through education reform should know if the graduates have met the requirements. Therefore, national or regional standard examinations to evaluate the competencies of all students are important steps in the practice.

Integrating twenty-first century competencies into education monitoring in national, regional or school based examinations

Some economies reformed standardized tests to ensure that their assessment can guide students to acquire the twenty-first century competencies upon graduation. This kind of national standardized test and centrally-set examination is a widespread practice in Europe. For instance, Wales, the United Kingdom, and the Czech Republic introduced such tests from 2013 and 2014 respectively. In addition, education authorities in Italy, Lithuania, Romania, and England planned to add new national tests in specific school years.[93]

After having issued the Melbourne Declaration, Australia tests student competencies such as literacy, calculation, and ICT via national examinations. Such examinations included two parts: The National Assessment Program-Literacy and Numeracy, (NAPLAN), an annual assessment for students in years three, five, seven, and nine [94]; and ICT Literacy Examination for students in years six through ten [95].

Besides national and regional examinations, school-based assessment has also been introduced in some economies, aimed to record and monitor students' development of "observable competencies". For example, in Malaysia, subject teachers are responsible for planning, developing and administering school-based assessments which, together with central assessment, sports and physical activities assessment, and psychometric assessment, form the assessment system in Malaysia.

This assessment system monitors the achievement in following educational goals, including: 1) to develop one's competencies as a global citizen, 2) to monitor student development to achieve the individual's full potential, and 3) to provide meaningful reports for individuals. In Indonesia, a student's final grade for each subject includes school–based assessment (30 percent) student personal attitudes (20 percent), and national examinations (50 percent). And personal attitudes is related to the development of LTLT (Learning To Live Together) competencies of students. [96]

Integrating twenty-first century competencies assessment into disciplinary tests

To integrate the competencies into courses of different subjects is an important way to realize the competency education. And this requires the assessment of competencies in these courses. New Zealand has integrated the monitoring of key competencies into its National Monitoring Study of Student Achievement (NMSSA). The country does not monitor students' key competencies separately in different curricula. There is no such design of independent assessment as is done in mathematics or reading. The key competencies are tested in various types of questions in various disciplines. Performances of competencies in each discipline have been given clear operational definitions. Therefore, students' key competencies are tested yearly, and the results published along with the monitored discipline. [97]

Evaluating problem-solving skills in real situations

Teaching based on real situations is an important way to develop students' competencies. Therefore, to monitor their achievement, some economies have assessed their students with various real situation cases. In France, students' proficiency in using multimedia tools and the internet acquired through a large variety of learning activities has been evaluated since 2001 within the framework of the Brevet informatique et internet (B2i), at primary, lower and upper secondary education levels. Five areas of digital competencies are further described which are associated with distinct reference points for each of the three levels of education considered. These areas are: mastering an ICT-based work environment; behaving responsibly; creating, producing, processing and using data; acquiring information; communicating and exchanging information. This framework also made different sets of standards for primary, lower and upper secondary school students.[98]

In the Hungarian National Assessment of Basic Competences (NABC), evaluation is not confined to the subject material itself, but focuses on whether students are able to use their knowledge and skills in reading and mathematical literacy in real life situations. Similarly, Belgium and Poland also highlight real life situations in cross-curricular assessment. In Belgium (Flemish Community), students' competencies in the domains of Society, Space, Time and Use of different information sources in Environmental Studies were tested in 2010. In Poland, the test at the end of primary education is entirely based on cross-curricular material and assesses performance in reading, writing, reasoning, information and the practical application of knowledge.[99]

In 2015 the National Compulsory Education Quality Monitoring System was established in Mainland China. The monitoring cycle spanned three years with two fields being monitored every year. The monitoring covers competencies such as reading, writing, problem-solving, scientific research, sports and health and aesthetics in the fields of literacy, mathematics, science, sports, art, morality, and other areas. [100]

Professional certificates

Many twenty-first century competencies are closely related to corresponding professions and occupations. Assessing these competencies through professional certificates is also an important way to carry out evaluation.

For instance, standardized tools for classroom assessment of digital competencies are quite widespread in Europe (EACEA/Eurydice, 2011a). A European level certificate, the European Computer Driving License (ECDL), is either regularly or occasionally used in around half of European countries, mostly in upper secondary education. The assessment process for obtaining this certificate relies on a mastery of seven groups of computer skills and competencies. A few more countries issue publicly recognized ICT certificates at different levels, which generally cover a similar set of competencies as in the ECDL. Belgium (French Community) has a non-compulsory ICT passport for primary and secondary education. Germany, Lithuania, Romania and the United Kingdom offer additional recognized qualifications in ICT skills while the Scottish Qualifications Agency also offers ICT certificates. [101]

4. RECOMMENDATIONS AND STRATEGIES

Examples provided in this section illustrate ways of promoting twenty-first century competencies education in the following aspects: curricula, teaching and assessment are three integrated parts in education. Establishing connections among these three aspects is helpful to improve the competencies education.

Integrating twenty-first century competencies education into curricula and developing supporting teaching resources

K-12 curriculum design is an important way to realize the goal of twenty-first century education. twenty-first century competencies education through official reform could integrate these competencies into existing curricula to form a complete framework of curriculum goals. In this way, education about all competencies could be taken into account when designing the curricula.

When selecting and designing curriculum content, we should focus on interdisciplinary practices resulting in effective learning, as well as disciplinary practices. Interdisciplinary themes based on real situations and twenty-first century competencies education could provide rich learning experiences to the new breed of students who know how to collaborate with others. Interdisciplinary themes could include major issues or events of regional development. In this way, competency education could have more diverse functions. STEM and emerging innovation and entrepreneurship curricula are two important interdisciplinary themes.

Developing supporting materials are essential during the curriculum reform for twenty-first century competencies education. Textbooks are the most important physical materials of competencies education. Moreover, a variety of resources related to competencies education should be open to education administrators, teachers, students and their parents.

Transforming teaching methods and becoming more student-centered and problem/project-based

The philosophy of student-centered teaching in real life situations could motivate students to learn, meet the demands of different students and promote learning in certain competencies. In the teaching process, the teacher-student relationship should also be changed. Teachers must go beyond imparting knowledge, to promote student innovation

and independence, provide good learning conditions, and organize learning activities. We should design and implement problem/project-based learning schedules, which is an important way to become student-centered and teach students how to take initiatives in the learning process and solve real problems.

Using diverse assessment measures to lead and promote twenty-first century competencies education

Formative assessment is very useful to understand, diagnose, and respond to the development of student competencies in a timely, continuous, and comprehensive manner. We should establish student files to record their complete, long-term performance, and at the same time develop formative assessment tools for certain competencies.

Countries and regions committed to developing the competencies should integrate competency education assessment into standard examinations for all students. When designing examinations, we should use real-life cases as much as possible to evaluate students' capacity of problem-solving.

Many twenty-first century competencies are closely related to corresponding professions and occupations. Assessing these competencies through professional certificates is also an important way to evaluate educational achievements.

Issues to be studied and explored

Firstly, education programs for different competencies are developing in a rather imbalanced manner. For some competencies sophisticated plans have already been formulated as a result of constant research and practices, such as the competencies for science and ICT. However, for many other competencies, practices remain rare, and huge challenges still exist in the nurturing and assessment of non-cognitive competencies. The competencies must be clarified and developed as a prerequisite to building curricula and education practices.

Secondly, curricula, teaching and assessment strategies discussed in this section are mainly related to the big picture of twenty-first century competencies, not tailored to any specific competency. We still need a systematic solution that integrates curricula, teaching plans or learning strategies, as well as targeted assessment tools that support the development of each competency.

Thirdly, we should continue to explore how to integrate twenty-first century education with existing curricula. For example, we should explore which competencies could be developed based on traditional disciplines and how to cultivate them. What are the corresponding learning methods? Which competencies must be developed through independent courses and how to balance the curricula of such competencies and those of the others? Are there better ways? Will such ways reshape existing curriculum design and reform learning methods? What is the ideal education system? There are many issues worth studying.

#5

SUPPORTING TWENTY-FIRST CENTURY COMPETENCIES EDUCATION

#5 SUPPORTING TWENTY-FIRST CENTURY COMPETENCIES EDUCATION

Education intended to develop twenty-first century competencies is complex and can only be accomplished through collaboration among governments, research institutes, communities, and other social organizations. Many economies and international organizations, therefore, have been working on systems to support this drive at all levels of education systems.

I. POLICY SUPPORT

Policies are vital for education based on twenty-first century competencies. Government agencies have published policy papers to drive and guide these education practices.

Advance twenty-first century competencies education as a whole

Starting with curriculum reform to advance the twenty-first century competencies education; providing guarantees by making related policies.

As a member of EU, Spain established in its Organic Act 2/2006 on Education (LOE) that the "curriculum should be understood as the set of objectives, basic competencies, contents, pedagogic methods and assessment criteria". This was the first time the term "basic competency" was used in education regulations. LOE demanded that common core curricula based on basic competencies be introduced to the state's compulsory education. Standards as to the definition of the eight basic competencies have also been formulated to specify how each discipline and subject contributed to the development of these

basic competencies. Specific strategies for the education of mother tongue literacy, foreign languages, science, digital literacy and entrepreneurship have also been put in place. The basic competencies are designated as the paramount objectives of compulsory education and must be accomplished by all students as they finish compulsory education.[102]

In 2007 Russia passed Federal Bill No. 309, namely, Change Regarding Carrying Out the Concept of National Education Standards and Structural Changes in the Laws of Russia Federation[103], thereby making it compulsory to develop students' competencies through various means at all education levels. After that, amendments to the standards of both primary and higher education should be based on the core competencies. For instance, its National Primary Education Standards[104] in 2010 specified the requirements for students' learning outcomes in three aspects: individual abilities and character, including self-knowledge, learning motivation, social interaction, sense of national identity; general learning abilities, such as the ability to master interdisciplinary knowledge, solve problems with interdisciplinary knowledge, and learn through cooperation; learning outcomes, such as the skills, knowledge, activities, methods, thinking models, and application of various disciplines.

In 2014 secondary education standards of various majors were issued one after another, specifying competency requirements of college graduates and putting these competencies into three types: general cultural competency, general occupational competency, and professional competency. Russia set specific federal standards on different majors and for students at different levels (bachelor, master and expert), and different regulations on core competencies of the above-mentioned three types were also set. According to Russian Federation Secondary Education Standards 01.03.01 Math (Bachelor)[105], core competencies are composed of nine general cultural competencies, four general occupational competencies and 11 professional competencies.

Promote the cultivation of individual competencies

Advancing competency education through policies aimed at one or more competencies; or through enhancing some aspects of the framework. Different emphases reflected that the needs of economies in different development phases and impacts of regional societies and cultures were different.

With government coordination, EU countries have carried out relatively large-scale action plans, most of which were focused on the competency

in the mother tongue and in science. Almost all European countries have developed a specific national strategy related to digital competency. Some strategies can be very wide-reaching, encompassing several areas such as e-government, infrastructure and broadband connectivity, ICT security, and e-Skills development along with ICT in schools; while some strategies focused exclusively on ICT education.[106]

In the French-speaking community of Belgium, a 2007 Parliamentary Decree was issued to strengthen education for active and responsible citizenship at schools. According to this decree, schools should organize interdisciplinary thematic activities and create student representative bodies to let students experience social life and citizenship. In the meantime, topics on citizenship education should be integrated into various subjects in primary and secondary schools. The decree also demanded that an expert commission of academic and teaching staff be set up to develop teaching and assessment tools for citizenship education.[107]

Ethics and values education were emphasized in Thailand's education reform. Thailand's National Education Plan (2002–2016), which was a framework for implementing education reform, laid out three objectives and eleven policy guidelines for implementation. The first objective held that the purpose of education was "inculcating and strengthening morality, integrity, ethics, and desirable values and characteristics" in students[108]. Special focus on ethics and values is also well reflected in The Basic Education Core Curriculum of Thailand.[109]

II. STRENGTHENING AUTONOMY

Education authorities at all levels and social groups have worked from various perspectives to implement twenty-first century competencies education.

Grant more autonomy to local education bureaus, schools and teachers

By strengthening the autonomy of regions, schools can tailor education to meet their unique characteristics and needs while still carrying out educational practices aimed at twenty-first competencies from various aspects.

In early 2014, the Israeli Ministry of Education invited researchers from six regions (Alberta, Canada, Australia, Britain, Finland, Hong

Kong SAR, China, and Singapore) to carry out a comparative study of school autonomy (school-based management) and curriculum reform for twenty-first century competencies. Researchers from these six regions and Israel represented seven education systems. They summarized the experiences of the development process of school autonomy in these seven systems and pointed out that school autonomy should be connected with curriculum reform, as well as being regarded as a prerequisite to such reform.[110]

Cooperate with research institutes or NGOs

Apart from education authorities, some research institutes and civil societies have also voiced their own opinions on twenty-first century competencies, thereby prompting deeper thinking and reform.

The US P21 was co-founded by multinationals and research institutes and put forward a framework for the twenty-first century competencies based on academic research. The framework and its core competencies were mirrored by the Common Core State Standards and developed by state governments after 2010[111]. C21 Canada (Canadians for 21st Century Learning & Innovation) took part in devising the framework of core skills, and in 2012 C21 Canada put forward a complete framework for twenty-first century competencies.112

Some organizations have started to promote the twenty-first century competencies globally. The World Wildlife Fund (WWF) carried out a large number of educational projects on environmental protection. For instance, between 1997 and 2007, it worked with China's Ministry of Education and British Petroleum to launch the Green Education Campaign for Chinese Primary and Secondary School Students, with the aim to incorporate environment and sustainable development education into the curriculum. By 2007 nearly 500,000 schools have been involved.[113]

In 2007 the Dome (Diversity and Outreach in Math and Engineering) Foundation, a non-profit organization established in Massachusetts, in the United States, founded the Global STEM Education Center. The global partnership of the center has expanded to the UK, France, the Netherlands, and Russia, with the goal of enabling the next generation to solve urgent problems in global and cross-cultural environments. The organization demonstrated through real cases and experience how to promote STEM education across various countries and regions.[114]

Aflatoun Child-Savings International is a non-governmental organization focusing on cultivating children's awareness and ability

to manage financial resources through social and financial education. Its program, composed of two kinds of courses, i.e. courses on society and on finance, aimed to teach students how to become socialized individuals and how to manage personal finances. The program has involved over 3.9 million children annually and has been implemented in 109 countries and has found 181 cooperating partners.[115]

III. USING SOCIAL RESOURCES

Provide students with authentic learning opportunities

Fully leveraging the support of communities and social organizations to meet the needs of social productivity and community living; providing authentic learning opportunities to support and promote twenty-first century competencies education.

When promoting core competencies, Canada enlisted parental and community engagement because communities can provide authentic learning opportunities both within and outside of the school which could help core competencies to be acquired and enhanced in real-life contexts. At the same time, mastery of core competencies brought many positive outcomes, including economic, social, environmental, financial and personal returns, and can prompt social development through students' personal development. In Beijing, hundreds of organizations including museums, research institutions, businesses and public service organizations have been declared learning bases for junior and senior secondary school students. Some of them held the comprehensive social activities centered around national, social and individual development with the aim to nurture students' affection for the nation; enhance their social and cultural competencies; their ability to deal with inter-personal relations; sharpen their sense of social participation and responsibility and national identity. The rest of them was for science practices which were mainly to cultivate students' competence in science. To gain credits in compulsory subjects, junior secondary school students needed to take part in comprehensive social activities at least ten times, and science practice for another ten times. All the fees incurred by their practices were supported by the government. These learning bases have enriched the education process in terms of both teaching resources and teaching staff.

Integrate competency education into vocational education

Occupational needs are important starting points for developing a twenty-first century competencies framework. Connecting with vocational education is an important way to pursue competencies education.

The United Kingdom, in pursuing competencies education, focused strongly on employers' views on education and their support for it. The policy-making framework of Britain mainly included three parties: individuals, employers, and the government. Among these three, employers have an important role in designing, formulating, and evaluating the core competencies framework. The government needs to support developing the skills and abilities required by employers or the job market. Thus an employer-led qualifications system is being created to give adults with few or no qualifications access to broad programs that develop the foundation of skills for employment and ensure that learning programs enable all young people to develop the skills, attitudes, and attributes that employers seek. [116]

IV. STRENGTHENING TEACHER TRAINING

Teachers are crucial to the success of efforts to develop competencies through curriculum, teaching and assessment. Many international organizations and economies have therefore designed and support teacher professional development.

Organizing training programs to ensure that teachers understand the meaning of twenty-first century competencies and master the proper teaching methods.

Since putting forward the notion of core competency,[117] KICE (Korea Institute for Curriculum and Evaluation) has been developing standards to evaluate the core competencies of students and programs to improve teachers' abilities. The curriculum reform of 2015 is currently underway, and KICE has developed core achievement standards and organized training for teachers.

The Committee for Science and Education set up by the Indian Academy of Sciences has organized a series of national activities including summer camps for academic research, research courses, lectures, discussions and mid-year seminars. The academy has also started

a publication on information and science education, called Resonance, for teachers' reference. Moreover, the academy has set up a database of prominent teachers across the nation, invited them to participate in science projects, and provided them with opportunities to collaborate with academy experts. Over the past decade, about 650 teachers have attended academic meetings. Teachers have given reports and shared their teaching experiences.[118]

High-tech enterprises are playing an ever-increasing role in training teachers. A large-scale and influential program in IT education, Intel® Teach Program, has helped K-12 teachers integrate technology effectively into classrooms and promote student-centered approaches, engaging students in learning and preparing them with critical skills for success in the digital world. More than 15 million teachers from 70 countries have participated in this program.[119]

Providing teachers with teaching resources and operable tools to help them transform ideas into practice.

Aside from training programs on teaching and learning, many economies are developing resources to serve teacher development. Education authorities of Gyeonggi-do and Incheon in Korea are developing various courses and learning materials aimed at cultivating future core competencies. The US provided teachers with resources, blended teaching tools and guidance for putting strategies into practice to help teachers determine what practices they might follow. Evidence of this is seen with P21, which has carried out a series of research on teachers' professional development and summarized and issued a series of supporting tools, some of which were excerpted in the following table.

Table 6: Tools for teacher professional development by US P21 (excerpt)

Support tools	Content
Professional Development: A 21st Century Skills Implementation Guide	A guide for state leaders, policymakers and/or district and school leaders with assessment tactics and examples to assist in statewide 21st century skills initiatives.

Support tools	Content
Professional Development for the 21st Century	Prepare teachers and principals to integrate 21st century skills into their classrooms and schools.
21st Century Knowledge and Skills in Educator Preparation	A collaborative project by the American Association of Colleges of Teacher Education and the Partnership for 21st Century Skills (P21)

Note. Retrieved from Partnership for 21st Century Learning (P21). Implementing 21st Century Skills. Retrieved Sep. 28, 2015, from http://www.P21.org/our-work/resources/for-policymakers # implementing

V. RECOMMENDATIONS AND STRATEGIES

On the whole, cultivating twenty-first century competencies in education has achieved broad consensus. Pursuing competencies in education is still in its infancy; support from relevant government and social organizations falls far short of actual requirements.

The systematic design for cultivating twenty-first century competencies in education is composed of four components: driving forces, frameworks, practices and support systems.

The four components are both independent and interdependent, forming an organic system; they should be considered both individually and as integral to the whole. In this system, the selection of driving forces could affect, to a large degree, the level of priority the competencies are given. The selected driving forces can, significantly, bring together governments, businesses and the public in support for the competencies frameworks. The framework design itself is the prerequisite to effective implementation of competency education. Education practice can, in turn, assess the feasibility of the framework. Key procedures of practice, including curriculum, teaching and assessment, should all support competency education. A support system should assure the coordinated operation of the whole. In pursuing competencies education, both the framework building and curriculum design should take these four components and others into consideration.

Setting up an all-dimensional support system both within and outside of the education system

The implementation of a concept needs the continuous support of a sophisticated system. For example, in its guidelines for promoting a new round of curriculum reform, Mainland China has put forward five tasks in comprehensively implementing the reform. These tasks:

- Define clearly and achieve coherent transitions of the education systems at all levels, elementary through postgraduate studies.

- Coordinate different subjects in education and make them mutually complementary.

- Improve academic benchmarks used for guiding textbook compilations, teaching, assessment, and examination.

- Give full play to teachers, officials, researchers, scholars, experts and non-educational stakeholders.

- Link the educational practices in class, at school, in social groups, families and society.[120]

In their book Systems for State Science Assessment, Mark Wilson and Meryl Betrothal pointed out that "a successful system of standards-based science assessment is coherent in a variety of ways", and it is "horizontally", "vertically" and "developmentally" coherent. [121] Similarly, developing twenty-first century competencies needs the support of such a coherent, three-pronged education system. The support system should enlist support both from within the schooling system (education authorities and school leaders), and out of it (research organizations, social organizations, businesses, communities, parents, and the public). Educational authorities can work with employment authorities and employers to provide education that can prepare students for the job market and equip them with special professional skills. Welfare authorities can provide training to disadvantaged groups (teenagers and adults included) to improve their skills.

Exploring professional development paths for teachers and making teacher training programs more effective.

Quality targeted teacher training has a direct and positive impact on the effectiveness of competencies education. First, effective teacher training should rely on courses which are derived from research on core competencies, curriculum, the teaching process, assessment methods, as well as best teaching practices. Second, quality tools and resources should be given to teachers so that they can quickly turn ideas into reality. Teacher training should focus not only on how to help

students acquire the competencies, but also on strengthening the teacher's belief in the competencies, awareness of their importance, and willingness to put time and effort into studying them.[122]

Developing systematic solutions that are replicable and scalable to promote twenty-first century competencies education

To carry out competency education, we need to develop systematic approaches to each competency or a group of competencies. These approaches include modeling, learning progressions, curriculum, teaching and assessment based on competencies and teacher training programs oriented towards the competencies. To make these approaches replicable, scalable and effective, we suggest the following SERVE model to present and analyze them. SERVE, an acronym for Solution, Example, Rules, Value, Education, is an influential standard put forward by the Research Institute for Educational Innovation of Beijing Normal University to select and achieve educational innovation.

Figure 9 The model of SERVE
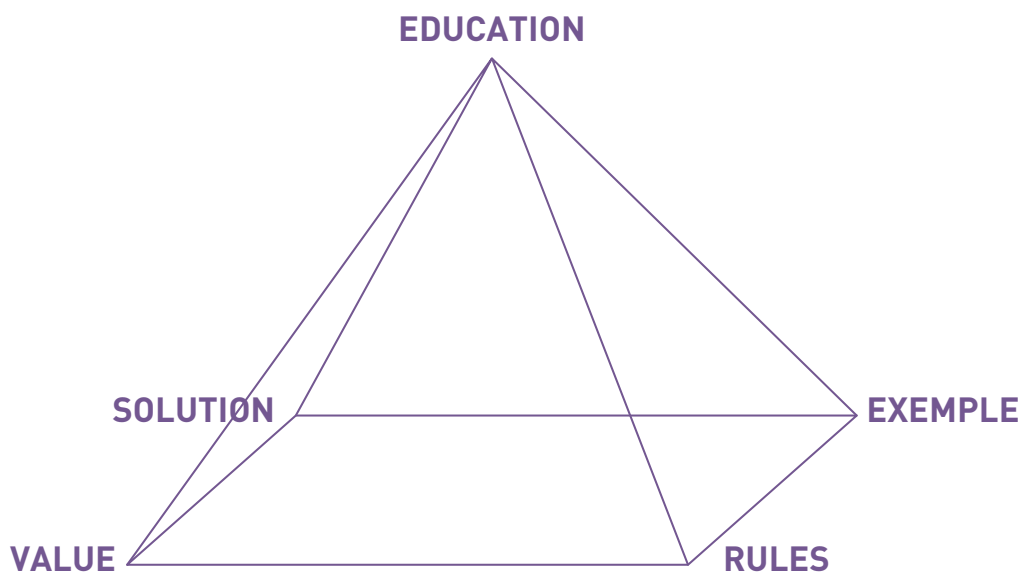
According to SERVE, systematic solutions for successful twenty-first century competencies should have the following features.

　　　　• Clearly defined Values and systematic understanding of the models and learning progressions of competencies.

• Clear and feasible Rules matched to the competencies.

• Feasible Solutions, approaches, and practices including curriculum, teaching and learning, teacher development and support.

• Successful examples to show successful stories.

• Together these features form an integrated whole and can serve as a foundation for transforming twenty-first century education from an idea to reality.

CONCLUSION

#CONCLUSION

The development of twenty-first century competencies provides us an opportunity to collectively explore what competencies citizens should possess, both today and in the future, and what kind of talents our education systems should cultivate. Educators have tried to envision the features of education, at any level, based on the competencies, and research has sought to address questions around how to achieve the goals of competency education. Globally, the competencies outlined in the frameworks presented in this paper are more than an idea; they have gradually ushered in a new generation of education systems reinforced by real life examples. In essence, competencies frameworks are a process for envisioning the paths of individuals and societies for the future.

For the purpose of the current study we would like to use the terms "twenty-first century skills and competencies" or simply "twenty-first century competencies". We believe that competency is not limited to cognitive elements (involving theory, concepts, or tacit knowledge), but also encompasses functional aspects (technical skills) as well as interpersonal attributes (social or organizational skills) and ethical values. A competency is, therefore, a broader concept that may actually

1. This report systematically presents the educational theories and global implementation of twenty-first century competencies.

This study is aimed at exploring the driving forces for twenty-first century competencies, the selection of competency elements, the experience of competency education and the establishment of support systems. And suggestions and recommendations are given accordingly.

a. Policy-making should be founded on a comprehensive, in-depth analysis of the driving forces with a global vision. When determining the driving forces, societies should fully consider their levels of socio-economic development, cultural traditions and geographical features. Education policies based on driving forces need to center on the nature and developmental needs of children.

b. Competencies should keep up with the requirement of times, global trends, regional demands, and local educational goals. The meaning of competencies should be precisely interpreted and a hierarchical and systematic network within and among competencies should also be established. The framework and education practice of twenty-first century competencies should feature lifelong learning. Time-tested competencies are also important in addition to the emerging ones.

c. It is important to integrate twenty-first century competencies education into curricula and developing supporting teaching resources. We need to transform teaching methods with more focus on student-centered and problem/project-based methodology. As well, diverse assessment measures should be implemented to lead and promote the twenty-first century competency education.

d. It is essential to consider the identification of driving forces, the selection of competencies, and the establishment of practices and support systems when designing the system of competency education. It could be realized through setting up an all-dimensional support system inside and outside the education system; exploring more effective professional development paths for teachers; developing systematic solutions that are replicable and scalable.

2. Imbalances in the emphasis of different driving forces and competencies should be avoided.

Different degrees of emphasis on different driving forces and competencies are also found in this research. Many framework makers consider more the needs of the socio-economic development than those of individuals' development, which calls for a change. For instance, most of the ten driving forces are centered on the social needs of a country or a region. More emphasis should be put on individual happiness and well-being than social factors. Competencies representing new trends of international education development, such as financial competence, leadership, cross-cultural and environmental competences should be incorporated into more frameworks.

3. Key issues in implementing competency education should gain attention from educators.

Despite much attention to the competency education, there is still a long way to realize the idea. Such a big change in the development of education has put forward several issues for educators as follows:

> • Driving forces for education and individual student's needs should be taken into consideration when making policies and developing twenty-first century competency frameworks.
>
> • Connotations of competencies and relationships across competencies should be fully reflected in frameworks so as to build up a well-structured system and provide effective guidance to the realization of competency education.
>
> • Research is needed on the development of competencies in different learning stages and even throughout life
>
> • Research is needed on how twenty-first century competency should be implemented, how it could be integrated with school curriculum, and how the integration should restructure school curriculum and change school direction.
>
> • Making competency education programs repeatable and easy to promote should be investigated.

4. An Oriental perspective provides an alternative view for further discussion of twenty-first century competencies.

At a global scale, twenty-first century competencies education is based on an assumption that future jobs and lifestyles pose new demands upon citizens, and accordingly the education systems should establish the framework of competencies for the twenty-first century and implement the education of competencies to meet these demands. But can we know that putting all the competencies together directly will cultivate a new generation of citizens who are competitive in the job markets and adaptable to future lifestyles? Will education really create wonders? What is the essence of education?

G.W. Leibniz, the German thinker called the "universal genius" by the Stanford Encyclopedia of Philosophy[123], is on par with Aristotle and Kant in philosophy, and with Newton in math. He invented the binary system about which he published several papers. In these papers, he elaborated on the Eight Diagrams in I'Ching, the finest of Chinese classics, and likened them to binary diagrams.[124] Similarly, traditional

Chinese philosophy emphasizes the way of nature, integrity and harmony, and thoughts and methods that are moderate and dialectical. This may help to improve our understanding of the twenty-first century competencies and will also be conducive to the related education practices.

Lastly, we would like to put forward several questions for readers' further thinking. First, with new competencies emerging to meet new challenges, are there any time-tested competencies helping people to "deal with changes with changelessness" (cope with shifting events by sticking to a fundamental principle/policy)[125]? Two and a half millennia ago, the Chinese philosopher Lao-tzu wrote in Tao Te Jing that "Humans imitate the earth, the earth imitates the heaven, the heaven imitates the Tao, and the Tao imitates nature", meaning all things in the universe follow the Tao or the way of nature, which is believed immutable. In the process of developing twenty-first century competencies, what is the ultimate logos or Tao that should guide us?

Second, Chinese philosophy was considered as holism, and a belief in harmony. The ancient Chinese thought on holism emphasizes that things cannot be separated. From this perspective, the development of the whole-person is not simply a total of all competencies. In spite of the fact that the competency frameworks are getting more and more comprehensive, maybe we should also think from the perspective of what being whole-person means, and the way to develop a whole-person.

APPENDIX: LIST OF ORGANIZATIONS & ECONOMIES STUDIED

	Organization & Economy		Income	
	Organization	Economy	High Income	Middle Income
OECD	•			
EU	•			
World Bank	•			
UNESCO	•			
APEC		•		
Australia		•	•	
Brazil		•		•
Canada		•	•	
Mainland China		•		•
Finland		•	•	
France		•	•	
Hong Kong SAR, China		•	•	
India		•		•
Indonesia		•		•
Israel		•	•	
Japan		•	•	
Korea		•	•	
Malaysia		•		•
New Zealand		•	•	
Philippines		•		•
Qatar		•	•	

	Organization & Economy		Income	
	Organization	Economy	High Income	Middle Income
Russia		•	•	
Singapore		•	•	
South Africa		•		•
Sri Lanka		•		•
Chinese Taiwan		•	•	
Thailand		•		•
United Kingdom		•	•	
United States		•	•	

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Table 3: OECD (2005) key competencies framework

Table 4: Categorization of 18 competencies

Table 5: The relation between common core state standards and 21st century competencies

Table 6: Tools for teacher professional development by US P21 (excerpt)

Figure 1: Flow chart of the research process

Figure2: Three categories of driving forces for 21st century competencies

Figure 3: Levels of focus in the documents for ten driving forces

Figure 4: Comparison of levels of focus on driving forces in economies by income level

Figure 5: US P21: A framework for 21st century student outcomes and support systems

Figure 6: Singapore's framework for 21st century competencies and student outcomes

Figure 7: Frequency of occurrence in the 29 frameworks for each competency

Figure 8: Levels of emphasis for competencies in economies, by income level

Figure 9: The model of SERVE

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