



[https://doi.org/10.31891/2308-4081/2024-14\(2\)-12](https://doi.org/10.31891/2308-4081/2024-14(2)-12)

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**FOREIGN EXPERIENCE OF SOFTWARE TESTING ENGINEERS' TRAINING:  
ANALYSIS OF EDUCATIONAL STANDARDS AND PROGRAMS  
OF ASIAN UNIVERSITIES**

**ABSTRACT**

*This paper studies educational practices in software testing and quality assurance across three major East Asian countries – China, Japan, and South Korea, which are globally recognized for their leadership in IT and technological innovation. The study examines the key strategies employed by these nations to cultivate highly skilled IT professionals by integrating national educational standards, curricula, and industry practices into their academic frameworks. China emphasizes embedding software testing as a key component within broader software engineering programs, aligning education with its national focus on technological self-reliance and innovation. Japan prioritizes innovative methodologies and quality management strategies, providing a precise and structured approach to IT education, while South Korea integrates hands-on training and industry collaboration to ensure that graduates possess both theoretical knowledge and practical skills. The findings underscore the important role of software testing and quality assurance as foundational elements of IT education. These practices not only enhance the technical competencies of graduates but also ensure their readiness to address real-world challenges in a rapidly evolving global IT landscape. By examining the experiences of China, Japan, and South Korea, the study identifies key lessons for Ukraine, which will benefit from adopting and adapting these approaches to enhance its own IT education system. Integrating software testing into the curricula, focusing on interdisciplinary integration, and aligning educational programs with industry needs could enable Ukraine to meet international standards and produce innovation in software engineering. Future research directions include exploring the nuances of program composition, the integration of software testing with other disciplines, and the adaptation of global best practices to local educational and industrial contexts. These areas of study hold significant potential to optimize educational outcomes and ensure that IT professionals are well-prepared to contribute effectively to both national and global IT market.*

**Keywords:** *IT education, software testing, East Asia, curriculum design, quality assurance, test automation, IT industry, educational standards.*

**ЗАРУБІЖНИЙ ДОСВІД ПІДГОТОВКИ ІНЖЕНЕРІВ  
З ТЕСТУВАННЯ ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ:  
АНАЛІЗ ОСВІТНІХ СТАНДАРТІВ ТА ПРОГРАМ АЗІЙСЬКИХ УНІВЕРСИТЕТІВ**

**АНОТАЦІЯ**

*У статті досліджуються освітні практики у сфері тестування програмного забезпечення та забезпечення якості в трьох провідних країнах Східної Азії – Китаї,*



Японії та Південній Кореї, які визнані світовими лідерами в галузі ІТ та технологічних інновацій. У дослідженні аналізуються ключові стратегії, які використовують ці країни для підготовки висококваліфікованих ІТ-фахівців, інтегруючи національні стандарти освіти, навчальні програми та індустріальні практики у свої академічні рамки. Китай приділяє особливу увагу впровадженню тестування програмного забезпечення як важливого компонента ширших програм з інженерії програмного забезпечення, орієнтуючись на технологічну самостійність і інновації. Японія акцентує увагу на інноваційних методологіях та стратегіях управління якістю, забезпечуючи структурований та точний підхід до ІТ-освіти, а Південна Корея інтегрує практичне навчання та співпрацю з індустрією для формування випускників із теоретичними знаннями та практичними навичками. Результати дослідження підкреслюють ключову роль тестування програмного забезпечення та забезпечення якості як базових елементів ІТ-освіти. Ці практики не лише підвищують технічну компетентність випускників, а й забезпечують їх готовність до вирішення реальних завдань у динамічному глобальному ІТ-середовищі. Аналіз досвіду Китаю, Японії та Південної Кореї вказує на важливі висновки для України, яка в змозі перейняти та адаптувати ці підходи для покращення власної системи ІТ-освіти. Інтеграція тестування програмного забезпечення в навчальні програми, зосередження на міждисциплінарній інтеграції та узгодження освітніх програм із потребами індустрії можуть допомогти вітчизняній системі освіти досягти міжнародних стандартів і стимулювати інновації в інженерії програмного забезпечення. Перспективні напрями подальших досліджень включають аналіз структури навчальних програм, інтеграцію тестування програмного забезпечення з іншими дисциплінами та адаптацію найкращих світових практик до локальних освітніх і промислових контекстів. Ці напрями мають значний потенціал для оптимізації навчальних результатів і забезпечення підготовки ІТ-фахівців, здатних ефективно сприяти розвитку національної та глобальної ІТ-індустрії.

**Ключові слова:** ІТ-освіта, тестування програмного забезпечення, Східна Азія, навчальні програми, забезпечення якості, автоматизація тестування, ІТ індустрія, педагогічні стандарти.

## INTRODUCTION

The IT sectors in China, Japan, and South Korea have undergone significant transformations over the past 20 years, evolving from regionally focused industries to global technology leaders. Despite geopolitical challenges, domestic political pressures, global pandemics, and economic crises, these countries have not only maintained their status as technological giants but have also demonstrated confident prospects for further growth in the 21<sup>st</sup> century.

In the early 2000s, China's IT industry was relatively small and largely focused on hardware manufacturing and lower-tier software development. However, over the past two decades, China has aggressively developed its domestic IT sector, resulting in a market value of over \$430 billion by 2020 (Xu & Zhang, 2020). Key drivers of this growth include the rapid expansion of its telecommunications network, the rise of local tech giants such as Huawei, Tencent, and Alibaba, and a focus on digital technologies like 5G, artificial intelligence (AI), and big data. China's "Made in China 2025" strategy, introduced in 2015, aims to reduce reliance on foreign technology and enhance domestic innovation, which has led to both cooperation and tension with global IT players.



Japan has been a leader in technology, particularly in the 1980s and 1990s, with major contributions to hardware, robotics, and telecommunications. By 2020, Japan's IT market had grown modestly to around \$200 billion, with more emphasis on software services, cloud computing, and advanced robotics (Japan External Trade Organization (JETO), 2021). International IT companies like Google, Microsoft, and Amazon have a significant presence in Japan, particularly in cloud and AI services. Japan's government has implemented policies such as the "Society 5.0" initiative, aiming to create a super-smart society by integrating AI, robotics, and big data into everyday life.

South Korea has seen one of the most dramatic IT transformations in the world. In 2000, South Korea's IT market was valued at approximately \$40 billion. Fast forward to 2020, and South Korea's IT sector had grown to over \$150 billion and is now a leader in mobile technology, broadband services, and semiconductors (Korean IT Industry Promotion Agency, 2021). South Korean government has supported its IT sector through policies that encourage innovation, such as "Digital New Deal", part of the broader Korean New Deal launched in 2020. This initiative aims to invest heavily in AI, 5G, and digital infrastructure.

In Ukraine, as in the leading Asian countries, we are witnessing rapid changes in the nation's political, economic, and industrial spheres. Despite cultural and geographical differences, the experience of integrating IT infrastructure and business as a significant part of state policy, demonstrated by countries like China, Japan, and South Korea, offers invaluable insights for Ukraine. These examples not only highlight pathways for growth but also provide a framework for Ukraine to undertake its own transformations. The experience of China, Japan, and South Korea in building robust IT markets and embedding software testing into their educational systems offer valuable lessons. Analyzing and applying foreign methodologies in teaching software testing is a strategic necessity for Ukraine, as the approach ensures the country's educational system remains competitive and relevant, equipping graduates with the skills to meet the highest international standards.

#### **THEORETICAL FRAMEWORK AND RESEARCH METHODS**

In recent years, several Ukrainian researchers have explored foreign educational models, particularly in Europe and Asia, to find ways to modernize Ukraine's higher education system, including IT education. One notable study is N. Bolotina's work that considers how Ukraine can adopt foreign educational experience though it primarily focuses on European countries. N. Bolotina briefly mentions the success of South Korean and Japanese education models, suggesting that their disciplined, technology-driven curricula could offer valuable lessons for Ukrainian IT education (Bolotina, 2018).

Europe and the United States have a long tradition of researching and analyzing foreign educational systems, particularly those of high-performing countries in Asia. A key work in this regard is G. Donnelly's analysis "Asian Educational Systems and Their Influence on Western IT Education", which discusses how countries like South Korea and Japan manage to produce highly skilled engineers, often with a focus on discipline and hands-on learning. Donnelly's study includes sections on software engineering and testing as core components of their curricula, highlighting how Asian IT education emphasizes both theory and practical application (Donnelly, 2020).

Research from within China, Japan, and South Korea often focuses on improving their own educational systems, with a particular emphasis on meeting the demands of their fast-evolving IT sectors. In K. Nakamura's "Innovations in Japanese IT Education", the author discusses Japan's efforts to modernize its IT curriculum by introducing more



project-based learning, particularly in software testing and quality assurance (Nakamura, 2021). K. Nakamura points out that Japan's Ministry of Education has recently pushed for reforms that align educational content with industry demands, particularly in advanced software engineering fields like test automation. Meanwhile, J. Lee has extensively written about South Korea's efforts to build a robust IT workforce. His paper highlights how South Korean universities are now integrating courses on software quality assurance and testing as mandatory components of IT degrees (Lee, 2022).

During the study, a number of theoretical methods were used, such as analysis and synthesis of the processed information, interpretation of the key concepts of the study, systematization and generalization of the research results, and the descriptive method.

#### **THE AIM OF THE STUDY**

The aim of this article is to study the experience of educational systems in China, Japan, and South Korea, with a particular focus on training specialists in software testing. The following objectives are set: 1) examine the key educational standards for IT engineers in these countries; 2) identify how software testing is reflected in the curricula of leading universities in these countries.

#### **RESULTS**

China, Japan, and South Korea were selected as representatives of East Asia due to their unique social, cultural, and economic characteristics, as well as their established positions as global technology leaders. This selection emphasizes the diversity and adaptability of higher education systems in the region, highlighting their distinct approaches to IT education and accreditation. While analyzing only a few institutions from these countries does not provide a complete picture, it offers valuable insights into the key practices and standards shaping their educational landscapes. For each country, a prominent national standard and a leading university were chosen to demonstrate local approaches and their alignment with global trends.

##### *1. Standards and curriculum of Chinese institutions*

China's educational system is highly centralized and governed by the Ministry of Education (MOE), which creates national standards for higher education, including IT disciplines. A major distinction from Ukrainian more decentralized and flexible system is China's reliance on standardized national exams like the "Gaokao" for university admissions. In terms of curriculum design, China ensures that all universities must adhere to specific national guidelines, which focus heavily on technology, engineering, and practical industry alignment. The most critical document shaping IT education in China is "National Standards for Undergraduate Professional Teaching Quality", issued by the Ministry of Education (Ministry of Education of the People's Republic of China, 2018). These standards lay out key areas of knowledge and competencies required for undergraduate IT students, ensuring that all institutions meet a baseline level of academic rigor and practical application. Key areas include:

- programming languages: Mastery of major programming languages like Java, Python, and C++;
- software development lifecycle: focus on all stages of the software development process, from planning and design to implementation and maintenance;
- computer systems: understanding of operating systems, computer architecture, and database management;
- practical skills: a significant emphasis on hands-on learning through projects, internships, and industry collaborations.



Software testing is not a standalone discipline in Chinese education but is integrated into broader software engineering and quality assurance courses. The “National Standards for Undergraduate Professional Teaching Quality” include references to software testing as part of the software development lifecycle and quality assurance processes. Students are expected to gain foundational knowledge in testing methodologies, such as unit testing, integration testing, and system testing, use automated testing tools and participate in projects where quality assurance, including testing, is an integral part of the software development process.

Tsinghua University is recognized as the premier institution for engineering and IT education in China. It closely follows national standards, such as the “National Standards for Undergraduate Professional Teaching Quality”, and offers an accessible curriculum, making it an ideal representation of how top Chinese universities structure their IT programs (Tsinghua University, 2023).

The Bachelor Program in Software Engineering at Tsinghua University is a four-year program known for its competitive admission process, which primarily relies on the National College Entrance Examination (Gaokao). International applicants are required to submit exam scores and demonstrate language proficiency in either Chinese or English, depending on the program’s instruction. Tuition fees for domestic students are subsidized by the government, while international students pay approximately \$4,500 per year. The program offers diverse specializations, including software development, artificial intelligence (AI), big data, and system design.

The “Software Testing and Quality Assurance (SE301)” course at Tsinghua University is a critical part of the software engineering curriculum. This course provides both theoretical knowledge and practical skills necessary for ensuring software reliability and performance (Liu, 2022). The key aspects covered in this course contain:

1. Testing Methodologies: key testing techniques, including unit testing, integration testing, system testing, and acceptance testing. Students learn the fundamental principles of creating test cases, identifying defects, and validating software against requirements.

2. Automated Testing: tools such as Selenium (for web testing) and JUnit (for Java applications) are taught as part of the curriculum. Students are expected to create automated test scripts, configure testing environments, and analyze test results.

3. Test Management Tools: The course also introduces students to industry-standard test management platforms to track defects, manage test cases, and document testing processes. Students gain practical experience using these tools in lab settings.

Speaking of practical application, students participate in lab sessions where they apply testing techniques to real-world software projects. They write automated test scripts and run them on actual software systems, which mimic industry-standard practices. Moreover, the students are required to complete a group project where they design a testing strategy for a complex software system. This involves identifying critical components to test, writing automated and manual test cases, and ensuring that the system meets specified quality standards.

#### *2. Standards and curriculum of Japanese institutions*

Japan’s educational system, while structured and centralized, allows for more institutional flexibility compared to China. The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) oversees national education policies, but universities have autonomy to adapt their curricula within national frameworks (Ministry of Education,



Culture, Sports, Science and Technology (MEXT), 2021). Admission into higher education in Japan is typically based on entrance exams, such as the National Center Test, which evaluates students' readiness for various university programs. Japanese universities, much like their Ukrainian counterparts, align with global education standards for engineering education. However, Japan places significant emphasis on providing students with highly specialized knowledge, particularly in technical fields like IT and engineering, while Ukrainian education leans more toward a broad-based, flexible model aligned with the Bologna Process.

Japan's educational standards are outlined in key policy documents such as the "Information Technology Engineers Examination (ITEE)", which provides competency standards for software engineering and IT education. The ITEE serves as a national qualification framework, ensuring that universities align their curricula with industry requirements. It provides a clear structure for evaluating student competencies in IT and engineering fields, with a particular focus on software engineering and systems design.

Software testing is explicitly mentioned in Japan's "ITEE" framework, particularly under the section on software lifecycle management. Japanese universities integrate software testing within broader software engineering and quality assurance courses, focusing on:

- Testing Methodologies: students learn various testing techniques, including unit testing, system testing, and user acceptance testing;
- Automated Testing: the curriculum covers the use of automated testing tools, ensuring students are well-versed in modern testing practices;
- Testing as a Core Competency: software testing is considered a core skill for IT professionals, with significant attention to test case design, debugging, and quality assurance.

In addition to classroom learning, students engage in practical testing through lab work and industry-sponsored projects, ensuring they gain hands-on experience in the testing and validation of software systems.

The University of Tokyo is widely regarded as the top institution for engineering and IT education in Japan. Its programs align closely with the national standards set by the MEXT, and its curriculum is available in open access, making it a model example of how Japanese universities implement IT education (University of Tokyo, 2023). The university also follows the ITEE framework.

The Bachelor of Engineering in Computer Science and Software Engineering at the University of Tokyo is a four-year program characterized by its highly competitive admissions process, which includes national and university-specific entrance exams. International applicants are required to submit SAT/ACT scores or equivalent qualifications and demonstrate language proficiency in either Japanese or English, depending on the program. Tuition fees for domestic students are subsidized, while international students pay approximately \$5,000 per year. The program offers specializations in software engineering, system design, artificial intelligence, and cybersecurity.

The "Software Testing and Quality Management" course at the University of Tokyo is a crucial component of the software engineering program. It focuses on ensuring software reliability and robustness through comprehensive testing and quality assurance practices. Key aspects of the course include:

1. Testing Techniques: the course covers essential testing techniques such as unit testing, integration testing, system testing, and acceptance testing. Students are taught to design effective test cases and create structured testing strategies.



2. Continuous Integration and Testing: the course introduces students to continuous integration (CI) practices, focusing on automated testing within CI pipelines. Tools like “Jenkins” are used to demonstrate how testing can be integrated into a CI workflow to ensure rapid detection of defects in software.

3. Quality Assurance: students learn about software quality metrics, including defect density, code coverage, and test effectiveness. The course emphasizes the role of testing in maintaining and improving software quality over time.

### *3. Standards and curriculum of South Korean institutions*

South Korea’s education system, like China’s, is highly centralized but places a unique emphasis on competitive entrance exams, particularly the College Scholastic Ability Test (CSAT), which determines university admissions. Unlike Ukraine’s more diversified approach to admissions, which considers both tests and prior academic achievements, South Korea heavily relies on a system centered around high-stakes testing. Once students enter university, the curriculum tends to be highly structured and closely aligned with industry needs, particularly in the fields of IT and engineering.

South Korea’s IT education is primarily shaped by the “Korean Engineering Education Accreditation” (KEEA), a rigorous accreditation standard that ensures all engineering programs, including IT and software engineering, meet industry expectations (Korean Engineering Education Accreditation (KEEA), 2020). Students are trained in the complete software lifecycle, from analysis and design to coding and testing, enabling them to contribute across all development phases. The KEEA emphasizes strong industry collaboration, offering internships and capstone projects with major corporations, and prioritizes global competitiveness by aligning programs with international IT standards and English proficiency. Software testing is seamlessly integrated into the curriculum, with students learning various methodologies, including unit, system, and user acceptance testing. Automated testing is heavily emphasized, often in partnership with industry, while hands-on lab work and internships further develop their practical skills in testing techniques.

The Bachelor of Science in Software Engineering at Seoul National University (SNU) is a four-year program known for its rigorous admission process. Domestic students must excel in the Korean College Scholastic Ability Test (CSAT), while international applicants are evaluated based on standardized tests such as the SAT/ACT and language proficiency in Korean or English (TOPIK or TOEFL). Tuition fees average \$4,000 annually for domestic students, supported by government subsidies, while international students pay approximately \$6,500 per year. The program offers specializations in cutting-edge fields, including artificial intelligence, blockchain, big data analytics, and cyber-physical systems (Seoul National University, 2023).

A key part of SNU’s software engineering curriculum is the “Software Testing and Quality Assurance” course, which equips students with essential skills to ensure software reliability and performance. The course covers comprehensive testing methodologies, such as boundary, stress, unit, and system testing, with a strong emphasis on designing robust test cases and debugging techniques. Students also gain hands-on experience with automated testing tools, including Selenium, and JUnit, enabling them to build scalable testing pipelines. The curriculum also focuses on software quality metrics, such as defect detection efficiency and code coverage, to drive continuous quality improvement throughout the development lifecycle. The program incorporates practical applications to reinforce theoretical knowledge.



## CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

China, South Korea, and Japan have developed robust educational standards to ensure their software engineering graduates are well prepared for the demands of the IT industry. China's national standards focus on embedding software testing within the broader software engineering curriculum, ensuring students acquire essential testing skills as a part of their understanding of the software lifecycle. South Korea, through the Korean Engineering Education Accreditation framework, emphasizes structured practical training and the development of testing competencies. In Japan, educational policies prioritize innovative methodologies that integrate testing as a critical component of quality assurance and software engineering practices.

The role of software testing in IT education varies across these countries but remains a foundational element of their programs. In China, testing is viewed as a critical step within the software lifecycle, ensuring students grasp its importance in maintaining system reliability. South Korea places greater emphasis on equipping students with hands-on experience in quality assurance, often linking educational efforts directly with industry projects. Japan, with its tradition of precision and innovation, focuses on aligning testing practices with broader quality management strategies, ensuring students are well versed in designing, validating, and implementing testing processes.

The educational systems in China, Japan, and South Korea demonstrate a strong commitment to producing highly skilled IT professionals. By embedding software testing into their curricula, these countries ensure that students not only acquire a solid foundation in theoretical principles but also gain the practical expertise necessary for addressing real-world challenges. This balanced and comprehensive approach equips graduates to make significant contributions to the global IT industry.

Looking ahead, Ukraine stands to benefit greatly by adopting and adapting the experiences of these countries. The integration of software testing and quality assurance practices into higher education, as well as the focus on aligning curricula with industry needs, can provide a valuable roadmap for advancing Ukraine's IT education. Furthermore, exploring the nuances and specifics of program composition and course content – such as their integration with other disciplines and alignment with interdisciplinary fields – offers promising prospects for future research. Delving into these areas could yield insights into how Ukraine can effectively tailor its educational framework to meet both national and global IT sector demands.

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