

# Integrating Digital Literacy in Secondary Education: A Comparative Analysis of Effective Teaching Strategies Across Asia

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**Abstract.** This research project examines the ways in which digital literacy is incorporated into the secondary education curriculum in various Asian countries. This study aims to investigate the comparative teaching strategies employed with the aim of enhancing students' digital competencies. Qualitative research methods were employed to obtain data through in-depth interviews, document analysis and participatory observation in secondary schools in five Asian countries: Indonesia, Singapore, India, South Korea and Japan. The findings indicate that technology-based strategies, teacher training and national policies play an instrumental role in the successful integration of digital literacy. The research validates that a comprehensive approach to the incorporation of digital literacy in secondary education in Asia necessitates an interwoven combination of pedagogical strategies, conducive policies and robust technological infrastructure. The insights gained from this research are invaluable for the formulation and refinement of an inclusive and effective digital literacy curriculum.

**Keywords:** Digital literacy, secondary education, teaching strategies, Asia, qualitative methods

## I. INTRODUCTION

The advent of digital transformation has precipitated significant shifts in numerous facets of life, including the domain of education. The advent of advanced information and communication technology (ICT) has ushered in a novel landscape, wherein novel methodologies for learning, teaching and interacting with information have emerged. In the context of education, digital transformation not only impacts the learning tools employed but also the pedagogical approaches, curriculum design and the competencies required for success in the global era.

The ability to understand, use and evaluate digital technologies effectively and ethically, which is defined as digital literacy, is becoming one of the key competencies of the 21st century. Digital literacy is a multifaceted concept that encompasses not only technical skills such as the use of software and applications, but also more complex abilities such as critical thinking, problem-solving, and analysing digital information. In the contemporary context where technology pervades almost every aspect of life, including the professional realm as well as social interaction, digital literacy has become a basic necessity rather than a mere complement. The secondary education stage plays a pivotal role in fostering this literacy, as at this stage learners begin to engage with technology in a more autonomous and sophisticated manner (Ivanova et al., 2024).

Asia, as the continent with the world's largest population and diverse socio-economic conditions, demonstrates significant variations in the approaches taken to integrate digital literacy into education. Developed countries such as Japan, South Korea and Singapore are characterised by advanced technological infrastructures and supportive education policies, facilitating a more comprehensive implementation of digital literacy. In contrast, developing countries such as India and Indonesia confront challenges associated with the digital divide between urban and rural areas, deficiencies in infrastructure and a lack of training for teachers.

The approaches taken by different countries reflect their specific local needs, cultural contexts and technological capabilities. In South Korea, for instance, digital literacy is integrated across all subjects through the use of Learning Management Systems (LMS). In India, an open-source-based approach is used to reach students in rural areas at low cost. Singapore, on the other hand, employs a highly structured strategy through

the adoption of national policies such as Smart Nation, which prioritises intensive teacher training and the provision of advanced technology (Tello-Gamarra et al., 2024).

The objective of this research is to explore and analyse the integration of digital literacy in secondary education, with a focus on three main objectives:

- 1) The objective of this study is to identify the digital literacy teaching strategies that have been implemented in different Asian countries. The study will map the various strategies employed to integrate digital literacy into the secondary education curriculum. These strategies encompass a range of approaches, from project-based methodologies that leverage online learning platforms to comprehensive training programs for educators to equip them with technological proficiency.
- 2) A comparative analysis of the effectiveness of strategies based on social, cultural and technological contexts. This comparison is conducted in order to gain insight into how factors such as the level of technology access, national policy support and cultural values influence the success or challenges encountered in the implementation of digital literacy. For instance, the culture of hard work and innovation in Japan enables students to develop critical digital skills, whereas in Indonesia, the participation of local communities often determines the success of the programme.
- 3) The objective is to provide recommendations for the enhancement of digital literacy implementation in secondary education. The objective of this research is to identify best practices from different countries and to offer recommendations that can be applied in a broader context. In addition to technical aspects, such as the provision of devices, the recommendations include human elements, such as improved teacher training and competency-based curriculum development.

## II. METHODS

### A. Research Model

This research was designed using a qualitative approach with the aim of exploring the phenomenon of digital literacy integration in secondary education in five Asian countries: Indonesia, Singapore, India, South Korea and Japan. A comparative study design was chosen to explore the differences and similarities of digital literacy teaching strategies across different social, cultural and technological contexts. This design allows for in-depth cross-country analyses to provide practical insights relevant to various education stakeholders (Koch & Fehlmann, 2024).

The selection of these five countries is based on significant variations in levels of technological development, educational policies and socio-cultural backgrounds:

1. Indonesia: A developing country with the challenge of a stark digital divide between urban and rural areas.
2. Singapore: A developed country pioneering the integration of digital technologies in the education sector.
3. India: Has a large and diverse population, with a focus on community-based solutions to address the digital divide.
4. South Korea: One of the countries with the most advanced technological infrastructure, integrating digital literacy with all aspects of learning.
5. Japan: A country with a focus on critical literacy and an ethics-based approach to the use of digital technology.

### B. Research Subjects

This research involved various relevant stakeholder groups:

- 1) Technology and Informatics Subject Teachers  
Teachers were selected because they spearhead the teaching of digital literacy in the classroom. A total of 20 teachers from each country were interviewed to gain insight into teaching methods, challenges and successes experienced.
- 2) Middle Grade Students.  
Students aged between 12-16 years were selected as this age group is the main target for digital literacy in secondary education. 30 students from each country were interviewed to understand their perceptions, experiences and needs related to digital literacy.
- 3) Education policy makers  
Policymakers from the ministry of education or related agencies in each country were selected for interviews. A total of 5 policy makers from each country were interviewed to gain insights into national

policies, technology initiatives and evaluation of digital literacy programme implementation (Ishtiaq, 2019).



Fig 1. Qualitative Method

### C. Participatory Observation

Researchers directly observed the learning process in classrooms using digital technology. Observations were made on:

- 1) The use of Learning Management Systems (LMS) or learning software.
- 2) Teacher-student interaction in technology-based learning.
- 3) How students complete digital-based tasks.
- 4) This observation provides contextual data that helps to understand how technology is actually used in daily practice, including its potential and constraints.

### D. Document Analysis

The following documents were analysed to complement the interview and observation data:

- 1) National Curriculum: To understand how digital literacy is designed and integrated into formal education.
- 2) Digital literacy module: To evaluate the content and methods of digital literacy learning.
- 3) Education Evaluation Report: To assess the results of digital literacy policy implementation.

### E. Data analysis

Data analysis was conducted using a thematic approach as formulated by Braun & Clarke (2006). The stages included:

- 1) Data Familiarisation. The researcher reread the interview transcripts, observation notes, and analysed documents to gain a thorough understanding. At this stage, initial ideas about relevant themes were noted.
- 2) Initial Coding. The data is broken down into small relevant segments, then given a code to describe the essence of the segment. For example:
  - 'Technology infrastructure challenges'
  - 'Student engagement in LMS'
  - 'Effectiveness of teacher training'
- 3) Identification of Key Themes.
  - Policy and infrastructure support.
  - Teachers' role in supporting digital literacy.
  - Students' perceptions of digital learning.
  - Challenges in technology implementation.

- 4) Interpretation and cross-country comparison. The identified themes were compared across countries to find patterns, similarities and differences. This analysis helps to understand how cultural, social and technological contexts influence the implementation of digital literacy in each country.

### III. RESULTS AND DISCUSSION

#### A. Digital Literacy Teaching Strategies

##### 1) Indonesia

Indonesia is implementing a project-based learning approach to improve digital literacy among secondary education students. This strategy places students as active actors in completing projects using digital technology, such as creating multimedia presentations, building simple applications, or conducting data-based research.

However, the implementation of this strategy faces major challenges, especially in areas with limited infrastructure. Some remote areas in Indonesia still suffer from limited internet access, lack of technological devices, and minimal training for teachers. Government efforts through programmes such as Digitalisation of Schools and Merdeka Belajar have helped provide devices such as tablets and computers, but their distribution has been uneven (A. Sari, 2024).

In addition, Indonesia also relies on local communities and private initiatives to support digital literacy, such as the Rumah Belajar programme by the Ministry of Education, Culture, Research and Technology, which provides a free online learning platform. However, the success of this project-based strategy largely depends on teachers' creativity in adapting the projects to students' local conditions.

Pros:

- Engages students actively and contextually.
- Develops critical thinking and collaboration skills.

Disadvantages:

- Unequal access to technology in remote areas.
- Lack of technology training for teachers in certain areas.
- Singapore: Advanced Technology Implementation with Intensive Training Programme for Teachers (Puspita, 2024).

##### 2). Singapore

Singapore is recognised as one of the leading countries in digital education. Through its Smart Nation policy and ICT Education Masterplan, the Singapore government has integrated advanced technology into the secondary school curriculum. Students are taught to use artificial intelligence (AI)-based software for data analysis, augmented reality (AR)-based learning, and virtual laboratory simulations (Toh & Looi, 2024).

This success is supported by an intensive training programme for teachers, which is conducted on a regular basis. The programme covers technical training, digital pedagogy, and technology-based classroom management. Teachers are encouraged to adopt problem-based learning methods that integrate digital tools in solving real problems.

Singapore also has excellent technological infrastructure, such as high-speed internet connections and digital devices in every classroom. Programmes such as SkillsFuture for Educators reward teachers who are innovative in utilising digital technology (Koyunkaya & Dede, 2024).

Pros:

- Advanced and equitable technology infrastructure.
- Systematic and continuous teacher training.

Disadvantages:

- High cost of implementing advanced technology.
- Potential access gap between students from different economic backgrounds.
- India: Utilising Open-Source Platforms for Digital Literacy Learning in Rural Areas

##### 3). India

India faces huge challenges in disseminating digital literacy to vast rural areas. To address this, the Indian government is utilising open-source platforms such as Diksha, Moodle and Google Classroom to provide low-cost access to digital learning that can be adapted to local needs (Patel, 2024).

The strategy also involves training students and teachers to use mobile-based technologies. Most students in rural areas only have access to mobile devices, so a mobile-first approach is highly relevant. In addition, the government provides digital content in various local languages, making it more inclusive.

However, the main challenges are the low level of technological literacy among teachers and limitations in basic infrastructure such as electricity and internet. Private initiatives such as Digital India are working with the government to build infrastructure in rural areas, including the installation of free Wi-Fi in selected schools (Mahapatra, 2020).

Pros:

- Low cost and high inclusivity through open-source platforms.
- Mobile-first approach suits local needs.

Disadvantages:

- Limited infrastructure in rural areas.
- Reliance on private initiatives for financing.
- South Korea: Integration of Digital Literacy in All Subjects through an LMS

#### 4). *South Korea*

South Korea is a pioneer in integrating digital literacy into all subjects. The government has developed national Learning Management Systems (LMS) such as e-Class and Smart Education Platform, which allow students and teachers to access course materials, assignments and assessments online (Nam et al., 2024).

Every subject, from science to art, integrates digital literacy in its learning. For example, in art, students are taught to use graphic design software, while in maths, they utilise AI-based data analysis tools.

South Korea's success is also supported by family education programmes, where parents are invited to participate in their children's digital learning. The government provides special training for teachers to maximise the use of LMS and other digital tools (Kim, 2023).

Pros:

- Thorough integration into all subjects.
- Strong support from the government and society.

Disadvantages:

- High academic pressure may affect students' well-being.
- Large operational cost of the LMS for maintenance.
- Japan: Emphasis on Critical and Ethical Learning through Case-based Modules

#### 5). *Japan*

In Japan, digital literacy is taught with an emphasis on critical and ethical learning. Students are not only taught how to use technology, but also how to critically evaluate information and consider the ethical implications of using digital technology.

Case-based modules are used to encourage students to think critically, such as decision-making simulations on data security or analyses of fake news. These strategies are designed to prepare students to be responsible digital citizens (Gutor et al., 2023).

In addition, Japan prioritises collaboration between schools and technology companies to create a curriculum that is relevant to industry needs. Teachers are trained to lead discussions and deep reflections on complex digital issues, such as data privacy and the impact of social media (Tamashita et al., 2024).

Pros:

- Focus on critical thinking skills and digital ethics.
- Curriculum that is relevant to the world of work.

Disadvantages:

- Limited implementation in rural areas.
- Additional workload for teachers to facilitate ethical discussions.

### B. *A Comparison of the Effectiveness of Digital Literacy Teaching Strategies in Asia*

#### 1). *The Role of Technology Infrastructure in Digital Literacy Success*

Countries with strong technological infrastructure, such as Singapore and South Korea, show higher success rates in integrating digital literacy in secondary education. A strong infrastructure makes it possible:

1. Availability of Devices and Internet Connection

- In Singapore, every student at the secondary level has access to a personal device, such as a tablet or laptop, which is subsidised by the government. In addition, high-speed internet networks are available even in rural schools, ensuring there is no digital divide between regions.
  - South Korea has one of the fastest internet networks in the world, allowing students and teachers to access digital learning platforms in real-time. This infrastructure supports the use of learning management systems (LMS) such as 'E-Learning Korea.'
2. Education Technology Development
    - In Singapore, the 'Smart Nation' initiative encourages the development of interactive digital learning applications specifically designed to support the curriculum. An example is the 'Student Learning Space' (SLS), a national platform that allows students to learn independently with digital modules.
    - South Korea is investing heavily in artificial intelligence (AI) for education, with platforms such as 'AI Tutor' helping to personalise learning based on individual student needs.
  3. Fast and Effective Technical Support
    - Advanced technology infrastructure also ensures responsive technical support. In Singapore, schools have specialised technical teams tasked with handling device and network issues, ensuring a smooth teaching-learning process.
    - However, countries with inadequate infrastructure, such as some parts of Indonesia and India, face challenges in ensuring equitable access. In rural areas, the lack of digital devices and internet connections is a major obstacle, although efforts have been made to improve this situation through initiatives such as 'Digital India.' (N. Sari, 2024)

## 2). Cultural Influences on Digital Literacy Approaches

Cultural factors play an important role in influencing how digital literacy is taught and integrated.

### 1. Japan: Emphasis on Critical and Ethical Thinking

- Japan's culture that highly values excellence and collective responsibility is reflected in its approach to digital literacy education.
- Critical Approach: Digital literacy modules in Japan emphasise critical analysis of digital information. Students are taught to verify information sources, understand algorithm bias, and evaluate the ethical impact of technology use.
- Case-based Learning: Teachers often use real-world case studies to help students understand the ethical and social implications of digital technologies, such as data security or the spread of false information.

### 2. India: Emphasis on Social Inclusion

- India faces significant social and economic inequality challenges, which affect access to digital education. However, the country is developing an inclusive approach to ensure digital literacy is accessible to all.
- Use of Open Source Technology: The Indian government encourages the use of open-source software, such as Android-based learning apps, to reach students in remote areas.
- Community-Based Initiatives: Many schools in India adopt a community-based approach, where digital literacy training also involves parents and neighbouring communities. This helps extend the impact of digital education beyond the classroom.

### 3. Singapore: Efficiency and Collaboration

- As a country with a culture of high efficiency, Singapore emphasises the use of technology to improve learning productivity.
- Collaboration in Learning: Learning systems like SLS are designed to encourage collaboration between students through online discussion features, group projects and problem-based learning.
- Rigorous Measurement of Success: Singapore's results-orientated culture is reflected in the evaluation of the success of digital literacy integration, which involves surveys, data analysis and regular curriculum revisions (Astratova & Rubene, 2024).

## 3). Influence of National Policy on Digital Literacy Success

### 1. Singapore: Smart Nation Initiative

- The 'Smart Nation' policy is one of the most comprehensive policies in support of digital literacy.
- Government Funding and Support: The Singapore government allocates a large budget for technology education, including subsidising digital devices and teacher training.

- National Curriculum Integration: Digital literacy is considered an integral part of the national curriculum, with the aim of producing 'Digital Natives' who are competent in the global labour market.
2. South Korea: ICT in Education Policy
    - South Korea has specific policies to accelerate the digitalisation of education, including:
      - Infrastructure Development: Provision of high-speed internet in all schools.
      - Teacher Training: The government organises intensive training for teachers to master new technologies.
      - Regular Evaluation: The policy includes regular evaluation of the effectiveness of technology use in the classroom, enabling continuous improvement.
  3. India: Digital India Campaign
    - Despite infrastructure challenges, the 'Digital India' policy helped improve digital literacy in secondary schools.
    - National Platforms: Portals like 'DIKSHA' provide digital resources in various local languages, enabling students and teachers from different backgrounds to access learning materials.
    - Awareness Campaigns: The government organises campaigns to raise awareness of the importance of digital literacy, especially in rural areas (Abdullayev et al., 2024).

### C. Common Challenges in Integrating Digital Literacy

In the quest to integrate digital literacy into secondary education in Asia, various challenges have emerged. The three main challenges affecting successful implementation are the digital divide between urban and rural areas, teachers' readiness to adopt new technologies, and student data privacy and security concerns.

#### 1). The Digital Divide between Urban and Rural Areas

The digital divide refers to the difference in access to information and communication technology (ICT) between more infrastructurally advanced urban areas and rural areas that tend to lag behind. These differences include access to technological devices, internet connectivity, and basic digital literacy.

##### 1. Contributing Factors

- Technology Infrastructure: In many Asian countries, rural areas often lack adequate technological infrastructure such as high-speed internet networks or availability of hardware (laptops, computers).
- Economic Inequality: Incomes are often lower in rural areas, making the purchase of technological devices less of a priority than basic needs.
- Lack of Capacity Building Programmes: Digital literacy training is often concentrated in urban areas, leaving rural areas with limited human resources in the use of technology.

##### 2. Impact on Education

- Learning Inequality: Students in rural areas have limited access to digital teaching materials, widening the learning gap between urban and rural areas.
- Low Level of Digital Literacy: Students and teachers in rural areas are often less exposed to technology, resulting in lower digital literacy than their urban counterparts.

##### 3. Case Study.

In India, the government launched the Digital India programme to reduce the digital divide. However, a UNESCO report shows that 27% of schools in rural India will still not have internet access by 2023, so the implementation of this programme has not been fully effective.

##### 4. Proposed Solution

- Infrastructure Investment: The government and private sector need to increase investment in internet infrastructure in rural areas, such as the use of satellite technology or 5G mobile networks.
- Technology Subsidy Programme: Provision of affordable technology devices for students and teachers in rural areas through subsidy or donation programmes.
- Local Training Centres: Establish technology training centres in rural areas to provide intensive training to teachers and students (Qin et al., 2024).

#### 2). Teachers' Readiness to Adopt New Technology

Teacher readiness refers to teachers' ability, willingness and confidence in adopting technology to support the learning process. Many teachers face difficulties due to lack of training and experience in using technology.

##### 1. Causal Factors

- Lack of Continuous Training: Teachers often do not receive sufficient training in using technology effectively.
- Fear of Change: Some teachers feel anxious or reluctant to try technology-based learning methods for fear of failing or losing control in the classroom.
- Inequality of Technology Availability: Not all schools have adequate technology devices, making it difficult for teachers to put their knowledge into practice.

## 2. Impact on Education

- Suboptimal Learning: Teachers' inability to use technology can make digital literacy integration less effective.
- Competence Gap Between Teachers: Teachers who are not skilled in technology tend to lag behind their more digitally literate colleagues.

## 3. Case Study

In Indonesia, the Guru Penggerak programme seeks to train teachers to use technology in learning. However, a Ministry of Education and Culture survey in 2023 showed that only 42% of teachers felt confident in using technology tools in the classroom.

## 4. Proposed Solution

- Intensive and Continuous Training: Organise practice-based technology training programmes for teachers, such as training on the use of Learning Management System (LMS) and digital learning applications.
- Digital Mentorship: Facilitate collaboration between digitally literate senior teachers and less experienced teachers.
- Teacher Incentives: Incentivising certification or stipends for teachers who successfully improve their technology skills (Nisa et al., 2024).

## 3). Student Data Privacy and Security Issues

In technology-based learning, the collection and storage of student data is inevitable. Problems arise when such data is not properly protected, making it vulnerable to privacy breaches, data theft or misuse.

### 1. Causal Factors

- Lack of Legal Awareness: Many educators and educational institutions do not understand the importance of student data protection.
- Absence of Specific Regulations: In some Asian countries, regulations related to student data privacy are still inadequate.
- Use of Third-Party Apps: Many schools use learning apps without assessing their level of security.

### 2. Impact on Education

- Parental Distrust: If student privacy is threatened, parents may be reluctant to support technology-based learning.
- Student Data Vulnerability: Students' personal information, such as address, medical history, or academic grades, can be misused by irresponsible parties.

### 3. Case Study

In 2022, a learning platform in South Korea experienced a data leak that affected more than 100,000 students. The incident sparked an outcry from parents and highlighted the lack of security in student data management.

### 4. Proposed Solution

- Increased Privacy Awareness: Train teachers and school administrators on the importance of data protection and security measures.
- Strengthening Regulations: Encourage the government to create specific regulations related to student data privacy, such as a child data protection law.
- Safe Technology Use: Only use apps and learning platforms that have been verified for security (Fadiyah & Widodo, 2024).

## IV. CONCLUSIONS

The incorporation of digital literacy into the secondary education curriculum in Asia presents a dual challenge and opportunity. It offers a means of preparing young people for the digital age, a period during which digital literacy will be a strategic asset. The findings of this study indicate that the successful integration of digital literacy is contingent upon the utilisation of technology in the classroom, in addition to three key components:



relevant teaching strategies, supportive policies and adequate technology infrastructure. Effective teaching strategies constitute the foundation for the development of digital literacy in secondary schools. The various countries under study demonstrate disparate approaches, reflecting their respective local needs and educational contexts. A balanced combination of teaching strategies, policies and infrastructure is essential for the advancement of digital literacy, which can serve as a catalyst for transforming education in Asia into a more inclusive, relevant and empowering force for students. The research findings confirm that the successful integration of digital literacy in secondary education in Asia requires collaborative efforts from a range of stakeholders, including governments, educators, communities and the private sector.

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