Digital Competency Gaps in Technology-Enhanced Japanese Language Instruction: Evidence from a Bibliometric and Thematic Analysis

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Abstract. Although digital tools are extensively utilized in Japanese language classes, little attention has been paid to understanding how they can be effectively integrated into instruction by teachers. To address this research gap, a literature analysis of 93 articles published from 2015 to 2025 in Scopus, Web of Science, ERIC, and Google Scholar was conducted using an analytical approach informed by concepts from the CALL, TPACK, and DigComp 2.2 frameworks. The results have revealed several trends, including significant growth in publication output starting in 2020, with the number of scholarly works nearly doubling. Still, the majority of the analyzed studies are set in university settings, with only up to 12% involving elementary or secondary classes. The most pressing research needs are not related to content knowledge acquisition or basic digital tool operation, but specifically to Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and TPACK. For instance, integrative TPACK is 1.9 points short on a five-point scale. This finding indicates that although teachers demonstrate competence in content knowledge and the use of technological tools, they experience challenges when combining all required skills to integrate technology effectively in their practice. Thus, it is imperative to focus further efforts on practical teacher development initiatives aimed at mastering intersectional skill sets, conducting research beyond universities, and improving the alignment of contexts and digital tools with DigComp 2.2.

Keywords: Digital Competency, Japanese Language Education, TPACK, DigComp, CALL, Educator Preparedness, Bibliometric Analysis.

1 Introduction

Over time, classrooms for learning foreign languages have undergone significant change. In today's classrooms, technology-based platforms, applications, and AI tutoring programs have replaced traditional textbooks and flashcards. Amid this transformation of language teaching methods, Japan is a unique example of language education. Recent data indicates that approximately 3.79 million people across 141 countries study Japanese, reflecting a significant global interest in the language. To make Japanese-language education effective, especially when teaching large groups, educators must

L. Warlina and S. Luckyardi (eds.), *Proceedings of the 9th International Conference on Business, Economics, Social Sciences & Humanities – Humanities and Social Sciences Track (ICOBEST-HSS 2026)*, Advances in Social Science, Education and Humanities Research 1029,
https://doi.org/10.2991/978-2-38476-607-9_16

possess high language proficiency and utilize available technological resources—a necessity that is also confirmed by learners' perspectives [1]. A recent study found that 81.40% of students enrolled in Japanese electives struggled with speaking, listening, writing, and reading. This data clearly shows that educators must utilize digital resources to help students overcome these challenges [2].

As the COVID-19 outbreak forced educators to switch to video-based learning without adequate training, many Japanese language instructors found themselves teaching online with insufficient experience [3]. Indeed, this was not an easy task, as conventional Japanese teaching requires extensive use of manual techniques such as stroke-order practice on paper and the demonstration of keigo in real-time conversations, which cannot be replicated in an online environment. However, research conducted in the post-pandemic period has predominantly focused on students' achievements. It has been noted that while most studies have investigated how technological tools assist learners, teachers' abilities in using these technologies remain largely unexplored [4]. Therefore, there remains insufficient knowledge of the specific domains in which Japanese language teachers find it challenging to use digital technologies. The matter warrants close attention given the peculiarities of the Japanese language, which has three distinct script systems (hiragana, katakana, and kanji) and several levels of language proficiency [5].

To address the existing research gap, a review of the literature was conducted to explore the relationship between the digital competence of teachers in Japan and technology-enhanced instruction from 2015 to 2025. This review utilized a combination of bibliometric and thematic analysis methods. Three conceptual frameworks were employed in the study: Computer-Assisted Language Learning (CALL), the Technological Pedagogical Content Knowledge (TPACK) framework [6], and the DigComp 2.2 framework [7]. The study followed the PRISMA 2020 reporting guidelines and focused on three research questions [8]. RQ1 examined trends and themes over the decade; RQ2 assessed the competency gap at the intersection of TPACK; and RQ3 explored the implications of this gap for future professional learning programs and curricula.

2 Literature Review

2.1 CALL and Teacher Readiness

The roots of CALL can be traced back to the 1960s. Its evolution can be classified into three major stages: a behavioristic stage (drill-and-practice), a communicative stage (interaction-driven approach), and an integrative stage (use of multimedia and internet technologies) [9]. Beyond the important distinction between using technology as a tutor and as a tool, the theory is further developed through the concept of normalization. This is defined as the moment when technology becomes so seamlessly integrated into everyday practices that people cease to take note of it [10], [11]. According to this definition, however, teaching Japanese languages still seems far from the normalized use of technology [12]. Although students have used such technological resources as Anki flashcard decks and kanji-recognition software individually, they have done so more inconsistently than institutions have [13]. It is argued that the success of CALL relies

heavily on how carefully technology is selected to connect students, materials, and educational goals; however, this exact decision-making process often becomes a major bottleneck [14].

The development of ICALL (Intelligent Computer-Assisted Language Learning) and, more recently, AI-powered conversational agents has raised expectations in language education. A groundbreaking study demonstrated that chatbots can provide meaningful grammatical feedback to learners of Japanese [4]. However, there is an important caveat: the chatbot's responses must be verified by a teacher to ensure alignment with curriculum objectives, particularly when the content includes sociolinguistic elements such as keigo (formal speech). The extent to which teachers are likely to utilize Computer-Assisted Language Learning (CALL) depends not only on the availability of infrastructure but also significantly on their confidence in their ability to implement it effectively [15]. Furthermore, it seems to be deeply rooted in teacher education. Researcher surveyed 100 graduates of a Japanese language program working across seven sectors. They found that ICT was the least developed among hard skills, indicating that the problem of technological readiness is present during the preparatory period and continues post-graduation [16].

2.2 TPACK–DigComp Integration for Competency Assessment

Seven distinct knowledge types are encompassed within the TPACK framework. CK, PK, and TK represent the basic knowledge domains, while PCK, TCK, TPK, and TPACK themselves emerge as intersectional domains. The strength of the framework lies precisely in this attention to intersections; the most valuable competencies occur at the boundaries between Types of knowledge rather than inside a single domain [6]. Research supports this proposition. Research supports this proposition; a comprehensive review of TPACK research in language education has consistently identified Technological Pedagogical Knowledge (TPK) as the weakest dimension [17]. An equally important recommendation based on this insight: the professional development efforts should aim precisely at these boundary dimensions and not treat technology training in isolation [18].

An alternative perspective is offered by DigComp 2.2, which breaks down digital competence into five domains: Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety, and Problem Solving [7], [19]. These domains are then assessed at eight competence levels; DigCompEdu, the educator-focused edition, is similarly tailored for teaching contexts [20]. Why can combining TPACK with DigComp yield significant analytical potential? Because TPACK is very good at mapping the intersections between Types of knowledge without setting any proficiency criteria, whereas DigComp establishes such criteria but disregards discipline-specific pedagogy [21]. It has been demonstrated that pre-service teachers score lower at TPK intersections—a conclusion drawn from TPACK analysis but quantifiable only through DigComp-aligned metrics [22]. These metrics have been utilized to confirm that digital content creation represents the lowest point on the digital competence ladder among foreign language teachers [1]. Consequently, this combination of

frameworks will be leveraged in the current research within the theoretical context of CALL [23].

3 Methodology

A hybrid approach to bibliometrics and theme analysis was adopted in the study, and findings are presented following the PRISMA 2020 guidelines [8]. Databases searched included Scopus, Web of Science, ERIC, and Google Scholar for the time period ranging from January 2015 through December 2025. The Boolean search query was created based on three groups of concepts: (i) Japanese language ("Japanese language" OR "nihongo" OR "Japanese as a foreign language"), (ii) technologies ("digital" OR "technology" OR "ICT" OR "CALL" OR "e-learning" OR "online learning"), and (iii) educators' competence ("teacher" OR "educator" OR "instructor" OR "competenc*" OR "literacy" OR "readiness" OR "TPACK"). These keywords were run against titles and abstracts. The initial sample size of 534 publications was deliberately reduced to 93 by selecting articles that considered the topic of educators' competency in the context of the Japanese language. See Figure 1 for details about our analytical framework. To recap, CALL is the domain; TPACK helps identify intersections among different types of knowledge; and DigComp 2.2 offers standards for benchmarking these intersections and for author keywords.

4 Result

A total of 534 papers were found through the search. Deduplication resulted in the retention of 378 papers for title and abstract screening. For a paper to be included, it had to address Japanese language education, digital technology, and educator competencies, and be published in either English or Japanese. Papers dealing exclusively with learner outcomes, standalone conference papers, and non-empirical works were excluded from consideration. The inter-rater agreement from a pilot study involving the first 40 papers was 87.5%.

Table 1. Summary of Database Search Results.

Database	Initial	After Dedup.	After the screen.	Final
Scopus	87	72	34	18
Web of Science	64	51	28	12
ERIC	43	38	19	8
Google Scholar	340	217	45	7
Total	534	378	126	45

The database of relevant literature has been intentionally reduced from 534 to 93 sources that specifically focus on educators' competencies in the Japanese language environment. The theoretical approach adopted is represented graphically (see Fig. 1).

To conclude, the discipline of CALL serves as the theoretical background, while the framework of TPACK helps achieve an analysis of different knowledge types at the required level.

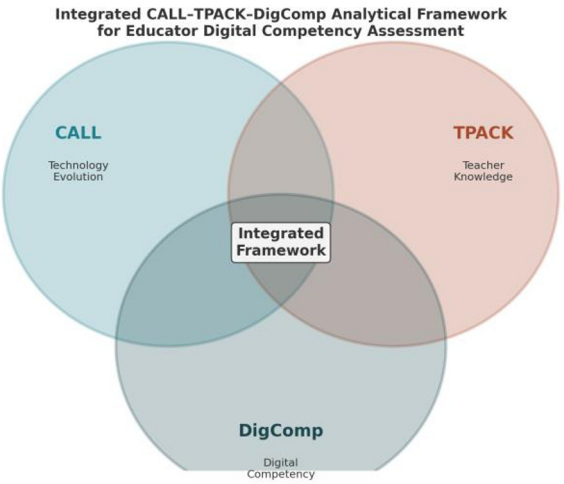

Fig. 1. Integrated CALL–TPACK–DigComp Analytical Framework for Educator Digital Competency Assessment.

In essence, CALL offers the field within which the research is situated, TPACK allows for the analysis of intersections between various forms of knowledge, while DigComp 2.2 offers standardized measures to evaluate such intersections. A full-text search generated 45 relevant studies out of 93 eligible articles. We applied the three-step process to analyze the literature: (1) line-by-line coding, (2) development of descriptive themes, and (3) creation of analytical themes [24]. The quality of research was assessed based on the Mixed Methods Appraisal Tool, 2018 version [25]. Cohen's kappa value for the double-rater evaluation was 0.72.

5 Discussion

5.1 Publication Trends and Geographic Distribution

For the years between 2015 and 2019, there were at most three to seven scholarly works published each year, suggesting that there is only a modest amount of research being conducted on an annual basis and a lack of widespread interest in the subject matter. With the onset of the pandemic, however, this trend was drastically changed, leading to the release of 12 papers in 2021 and 2022 before climbing up to 14 papers in 2024 [4]. While there has been a rise in the number of papers produced, one should be wary

of the fact that most of the researchers come from only a handful of countries, which might hinder the generalizability of the research results (see Fig.2).

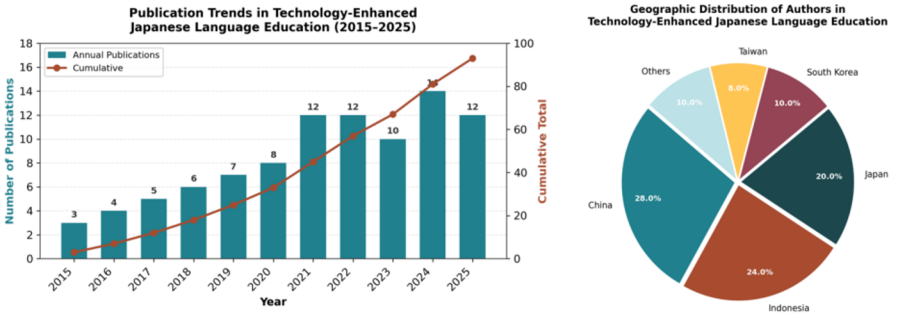

Fig. 2. Publication Trends (2015–2025) and Geographic Distribution of Authors in Technology-Enhanced Japanese Language Education Research.

Geographically, there are three countries that account for about 72% of authorship: China (28%), Indonesia (24%), and Japan (20%). The presence of these three countries can be attributed to the fact that Japanese language courses have been established for quite some time and on a large scale in these countries. One possible drawback of the study is its generalizability in different educational and geographical settings.

5.2 Digital Media Typology and TPACK Competency Gap Analysis

Video applications accounted for the largest proportion of the tools studied, at 14 applications. Multimedia applications followed, with 12, while mobile-assisted language learning was a close third with 11 tools. The final category includes newer applications including artificial intelligence chatbots (8 studies), gamification apps (6), and virtual reality (5). These types of media have only appeared since 2020, requiring higher competency from the educators. The main conclusion can be found in the TPACK competency-gap data, where CK, PK, and TK are relatively well-developed; however, the latter is noticeably weaker. The greatest lack of competence can be found in the intersection domains, where more competency is needed. The larger need for integrative knowledge in a particular tool correlates with lower readiness of teachers. Table 2 illustrates the intersection between media categories and their corresponding TPACK domain with the level of educator readiness found in the literature.

The TPK has 1.4-point deficiency, TCK 1.5-point deficiency, and integrative TPACK where teachers are expected to integrate all the three fields is 1.9 points deficient out of a total 5 points. This shows that although teachers have basic competencies, there is some challenge in integrating them in their work. After this discussion, we then move onto the DigComp 2.2 mapping shown in Figure 4 below.

Table 2. Digital Media Types and Associated Educator Competency Requirements.

Media Type	n	TPACK Domain	Demand	Readiness
Video-based	14	TCK	Moderate	Moderate-High
Multimedia	12	TPK	High	Moderate
Mobile (MALL)	11	TK-TCK	Moderate	Moderate-High
LMS	9	TPK	Mod.-High	Moderate
AI chatbots/ITS	8	TPACK	Very High	Low
Gamification	6	TPK-TCK	High	Low-Moderate
Virtual reality	5	TPACK	Very High	Very Low

However, the key story is in the TPACK gap competence data. CK and PK which constitute the basic knowledge fields fall almost within what is considered as sufficient in literature while TK has some moderate deficiency. The most disturbing gaps in terms of findings occur in the intersection areas. The distribution of different forms of digital media (left side) and the competency gaps in a radar chart (right side) (see Fig.3).

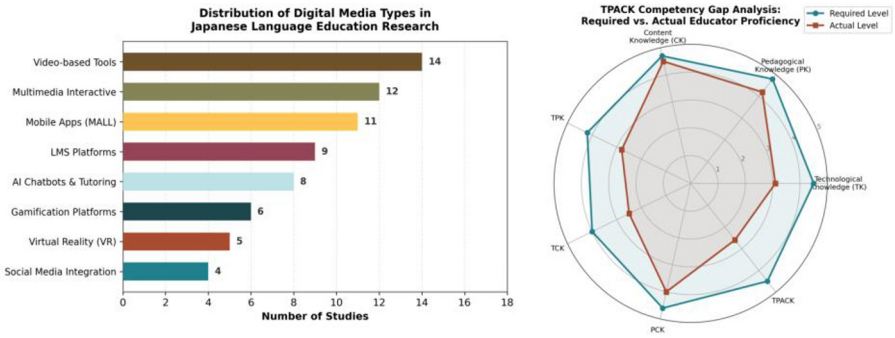

Fig. 3. Distribution of Digital Media Types (left) and TPACK Competency Gap Analysis: Required vs. Actual Educator Proficiency (right).

In other words, TPK is underdeveloped by 1.4, TCK by 1.5, and integrative TPACK—the domain that necessitates the teacher to integrate all three knowledge domains at once—by 1.9 on a five-point scale. These results corroborate previous findings obtained through different methodological approaches, indicating that while teachers possess the requisite competencies within individual domains, the integration of these components remains highly challenging [17], [22]. Let us now look at the DigComp 2.2 mapping in Fig.4.

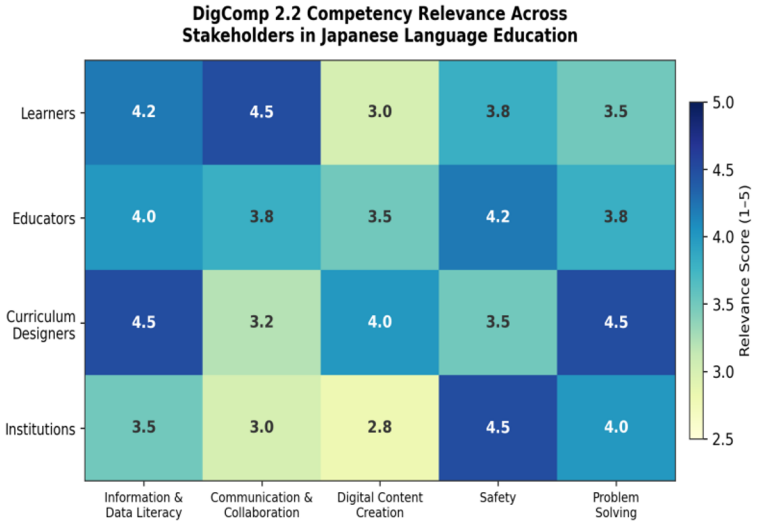

Fig. 4. DigComp 2.2 Competency Relevance Across Stakeholders in Japanese Language Education.

The greatest weakness that can be noted in both institution and educator scores is in Digital Content Creation, where the average score for institutions is 2.8 and for educators, it is 3.5. The above scenario correlates with TPACK where content technology integration was found to be the weakest domain. The other issue that can be noted is that of the curriculum designer where there is the highest score in problem-solving (4.5) but low scores in safety (3.2).

5.3 Key Challenges

Table 3 consolidates the principal challenges identified across the reviewed literature.

Table 3. Key Challenges in Educator Digital Competency Development.

Challenge	n	Severity	Key Findings
Training gaps	34	Critical	76% report insufficient PD
Intersectional deficits	31	Critical	TPK-TCK gaps avg. 1.4–1.5 pts
Infrastructure	28	High	Uneven access across regions
Assessment standards	22	Mod.-High	Lack of unified benchmarks
Institutional support	19	Moderate	Limited time/resources
Cultural/linguistic	15	Moderate	Script complexity adds difficulty

Training shortcomings and issues at the boundaries between fields were seen as key problems that are closely interconnected. Hardware access is an important factor, but it

is not enough; teachers need help to develop their integrative competencies. Workshops are too short to instill professional wisdom on how to combine technology and subject teaching. Professional development of this kind requires practice over time, which most educational establishments have not been able to provide thus far. Additionally, since there is no unified definition of competencies required in teaching Japanese, educational establishments find it hard to formulate their professional development goals.

6 Conclusion and Recommendation

Reviewing a total of 93 papers using the CALL-TPACK-DigComp framework produces three main results. To begin with, the analysis shows an evident increase in number in relation to publication trends (RQ1). While there has been a considerable increase since 2020, almost twice the number of papers was published. However, this rise is not consistent in all geographical areas and educational levels. Most research conducted in this topic comes from East and Southeast Asian countries and is focused on higher education, while only 12% of studies focus on other education levels.

In response to competency gaps (RQ2), the major challenges occur at the interplay of different knowledge areas. For TPK, the gap is 1.4 points; for TCK, it is 1.5 points; and for the integrated application of TPK, TCK, and TPACK, there is an even greater gap of 1.9 points. Complicating matters even more, the complexity of the Japanese language poses its own unique problems. The challenges for learners varied based on word types in terms of the N5-N3 proficiency levels, suggesting that teachers need to be selective about the digital tool used in teaching vocabulary based on specific content [27]. Professional development activities have been shown to be ineffective in achieving such an integrative decision-making process [26].

Based on the above-mentioned results (RQ3), three recommendations are provided. Firstly, professional development activities should focus on TPK-TCK intersection and consist of long-term experiential learning rather than one-off sessions. Secondly, further research should focus on elementary and middle schools, which have received very little attention thus far. Finally, competency measurement should involve using criteria based on DigComp 2.2. It is necessary to acknowledge recognized limitations of the literature in question. For example, grey literature and non-English/non-Japanese publications are probably understudied in this review, and self-reported measurements of competencies are known to be prone to social desirability bias. As a result, the actual gap between self-assessed and real competencies of educators might be greater than what we observed here.

Further research should involve direct observations of teachers' competency in the classroom and longitudinal monitoring as well as cross-cultural comparison in order to see the role of cultural norms and institutional policies on developing teacher competencies in digital literacy.

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