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Digital competencies and development strategies of librarians at Universitas Negeri Padang in 4.0 era

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Abstract

Rapid digital transformation in the Industrial Revolution 4.0 era has shifted academic libraries into digital resource hubs, requiring librarians to adapt their competencies to meet the ever-evolving demands. This study is urgently needed to explore how the digital competency gap among librarians affects the effectiveness of library services in the digital era. This study aimed to measure the transformation of Universitas Negeri Padang Librarians in Industry 4.0. The research method used a sequential explanatory mixed-methods design, combining a cross-sectional survey of all 26 UNP librarians with follow-up in-depth interviews. The competencies assessed included device and software operation, information and data literacy, communication and collaboration, digital content creation, security, problem-solving, and self-development. Results showed that librarians excelled in basic skills such as ensuring internet connectivity (M = 7.08, SD = 1.055) and maintaining ethical digital communication (M = 6.85, SD = 1.190). However, challenges persisted in advanced areas such as software troubleshooting (M = 5.96, SD = 1.509) and creating innovative digital solutions to improve patron experience (M = 4.85, SD = 1.736). Interviews revealed a high dependency on technical support, limiting librarians' independence in solving technical problems. The findings underscored the need for targeted training in problem-solving, digital innovation, and advanced application use, supported by improved infrastructure and access to sophisticated tools. This study concludes that improving the digital competencies of librarians is essential to support sustainable digital library services and strengthen the development of library science in Indonesia.

Keywords: Librarian transformation; Digital competencies; Librarian development strategies; Digital transformation; Industry 4.0

Kompetensi digital dan strategi pengembangan pustakawan Universitas Negeri Padang di era 4.0

Abstrak

Transformasi digital yang cepat di era Revolusi Industri 4.0 telah mengubah perpustakaan akademik menjadi pusat sumber daya digital, yang mengharuskan pustakawan menyesuaikan kompetensinya agar dapat memenuhi tuntutan yang terus berkembang. Penelitian ini mendesak dilakukan untuk mengeksplorasi bagaimana kesenjangan kompetensi digital pustakawan memengaruhi efektivitas layanan perpustakaan di era digital. Studi ini bertujuan untuk mengukur transformasi pustakawan Universitas Negeri Padang di industri 4.0. Metode penelitian yang, digunakan desain mixed-methods eksplanatori sekuensial, yaitu survei potong lintang terhadap seluruh 26 pustakawan UNP, yang kemudian diperdalam melalui wawancara mendalam. Kompetensi yang dinilai meliputi pengoperasian perangkat dan perangkat lunak, literasi informasi dan data, komunikasi dan kolaborasi, pembuatan konten digital, keamanan, pemecahan masalah, dan pengembangan diri. Hasil penelitian menunjukkan bahwa pustakawan unggul dalam keterampilan dasar seperti memastikan konektivitas internet (M = 7,08, SD = 1,055) dan menjaga komunikasi digital yang etis (M = 6,85, SD = 1,190). Namun, tantangan masih muncul dalam area lanjutan seperti pemecahan masalah perangkat lunak (M = 5,96, SD = 1,509) dan menciptakan solusi digital inovatif untuk meningkatkan pengalaman pengguna (M = 4,85, SD = 1,736). Wawancara mengungkap ketergantungan tinggi pada dukungan teknis, yang membatasi kemandirian pustakawan dalam menyelesaikan masalah teknis. Temuan ini menegaskan perlunya pelatihan terfokus dalam pemecahan masalah, inovasi digital, dan penggunaan aplikasi lanjutan, didukung oleh peningkatan infrastruktur dan akses ke perangkat canggih. Penelitian ini menyimpulkan bahwa peningkatan kompetensi digital pustakawan sangat penting untuk mendukung keberlanjutan layanan perpustakaan digital dan memperkuat perkembangan ilmu perpustakaan di Indonesia.

Kata Kunci: Transformasi pustakawan; Kompetensi digital; Strategi pengembangan pustakawan ; Transformasi digital; Industri 4.0

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INTRODUCTION

Universitas Negeri Padang (UNP) has demonstrated a strong commitment to developing a digital-based library. This is evident through the establishment of technological infrastructure and digital services such as the Online Public Access Catalog (OPAC), online book lending, literature search services, digital repositories, digital Collection of Scientific Works (KKI) services, and access to electronic journals (Perpustakaan UNP, 2016). However, the success of digital library transformation relies not only on the available technology but also on the competence of librarians in managing and providing digital-based services. The lack of studies focusing on the digital competence of UNP librarians creates a gap that needs to be addressed urgently, as low competence levels may hinder optimal library utilization (Bishop et al., 2023). Therefore, research is needed to map the digital competencies of librarians at UNP and design strategies to enhance these competencies in support of optimal digital library services.

The Industrial Revolution 4.0 era and the COVID-19 pandemic have accelerated digital transformation across various sectors, including academic libraries (Ali & Gatiti, 2020). Barnes (2020) emphasized the crucial role of information and communication technology in everyday life, particularly as the pandemic has impacted various aspects, including work, education, healthcare, and entertainment. Libraries are now required to become hubs of information resources and digital learning, effectively supporting educational and research processes (Chen et al., 2022; Ocran & Afful-Arthur, 2022). Furthermore, the significance of adequate technological infrastructure and information resources, librarians are a key element in facilitating this transformation. As information managers, librarians play a role in providing information accessibility, enhancing literacy in academic communities, and supporting research activities (IFLA & EIFL, 2021; Manuell, 2017). This requires librarians to possess digital literacy, which encompasses a set of skills and knowledge needed to engage effectively with digital technologies in thoughtful and efficient ways. It involves the ability to critically analyze, evaluate, and utilize digital tools and platforms to support their roles (Negi & Sain, 2023). However, the advancement of information technology has expanded librarians' roles into agents of change who contribute to digital content management, technology-based reference services, enhancing information and digital literacy, and ensuring the preservation and sustainable access to digital information (IFLA & EIFL, 2021; Tolmach, 2022; Singeh et al., 2021). Mansour (2017) also asserts that university librarians require higher levels of Information and Communication Technology (ICT) literacy to regularly update and expand their abilities in using digital skills. This further shows the importance of improving digital competencies to support the role of librarians in the era of digital transformation. In interviews with eight UNP librarians, several common challenges in digital transformation emerged.

First, none had ongoing training on new digital tools. One librarian said, "When the OPAC goes down or needs updating, I must wait for IT support because no one ever taught me how to troubleshoot on my own." Second, six out of eight felt overwhelmed by the many platforms, such as the digital repository and KKI collection interface. They lacked clear usage guidelines or competence checklists. A senior librarian mentioned, "I spend more time figuring out

which menu to click than actually helping users find resources."Finally, all interviewees noted that peer-to-peer learning sessions were their only opportunity to learn new skills. However, these sessions were rare and often occurred outside working hours, which reduced participation and skill retention.

This study aims to assess the digital competency levels of UNP librarians in providing digital library services and designing strategies for enhancing librarian competencies to support effective and sustainable digital services at the UNP Library. The substantial investment made by UNP in developing its digital library demands the readiness of librarians as service managers. Therefore, an appropriate competency improvement strategy is crucial to ensure optimal utilization of resources. Moreover, the limited literature on librarian competencies in Indonesia underscores the urgency of this study. This study is expected not only to provide recommendations for UNP but also to contribute to the development of library science in Indonesia.

The digital competencies of librarians in academic libraries include skills and knowledge in managing digital resources and providing effective services (Khan & Bhatti, 2017). These competencies include managing digital library infrastructure, digitization policies and standards, cost planning, staff management, evaluation, user training, pedagogy, communication, and digital skills for digital content preservation and creation (Khan & Bhatti, 2017; Baro et al., 2019; Anyaoku et al., 2019; Saib et al., 2023). Additionally, a study by Luo & Tang (2024) reveals that skills in computing, programming, and web technology are vital competencies for librarians. These competencies are essential to ensure that librarians can manage digital resources, improve digital literacy, and provide high-quality services to users.

A number of studies have explored librarians' digital competencies in various contexts. The study by Khan & Bhatti (2017) found that librarians in universities of Punjab province, Pakistan, have a basic level of digital competence, with three main categories, namely digital content development, management and protection. Research by Baro et al. (2019) in Africa showed that librarians have a moderate level of digital literacy, with low ratings on certain skills such as metadata and website development. Okeji (2020) at Hasanuddin University, Indonesia, found a significant relationship between digital competency and librarian performance, although the measurement of these competencies did not use a strong theoretical framework. Meanwhile, Ariani et al. (2023) successfully mapped the digital literacy competencies of librarians in special libraries using a conceptual framework based on UNESCO and other international organizations. From these studies, several gaps require further research. The study of Khan & Bhatti (2017) focused on digital libraries in Pakistan, while the study of Baro et al. (2019) did not provide details regarding the validity of their measurement instruments. In Indonesia, the study of Okeji (2020) is relevant, but lacks a comprehensive theoretical framework. In contrast, the study of Ariani et al. (2023) uses a validity-tested framework, but is limited to the context of specialized libraries. This study offers novelty by focusing on academic library librarians at Universitas Negeri Padang (UNP), using the framework of Ariani et al. (2023), and developing strategies to improve librarian competencies.

RESEARCH METHODS

This study used a mixed-methods research design with a cross-sectional survey method. The descriptive approach measured and described the digital skills of all 26 UNP librarians simultaneously. The cross-sectional survey facilitated data collection from each person and found skill gaps to guide development strategies. This study aimed to measure the digital competence of librarians at Universitas Negeri Padang (UNP) and design strategies for its development.

Competence measurement was conducted using a quantitative approach, with the population consisting of all 26 librarians at UNP. Sampling was performed using total sampling, which is a type of non-probability sampling technique due to the population being less than 100 people (Sugiyono, 2017). According to Bougie (2016), total sampling is particularly effective when the population size is small, ensuring that every member of the population is included in the study. Atmazaki et al. (2023) similarly define total sampling as the inclusion of the entire population in a research project.

The research instrument was developed based on the Digital Literacy Index Framework for Libraries, which included variables such as device and software operation, information and data literacy, communication and collaboration, digital content creation, security, problem-solving, and self-development. The validity of the instrument was tested by calculating the correlation between variables, while its reliability was measured using Cronbach's Alpha. A Cronbach's Alpha result ranges from 0 to 1, with an acceptable reliability score being 0.7 or higher, as suggested by Heale & Twycross (2015). According to Heale & Twycross (2015), validity refers to how accurately a concept is measured in a quantitative study, while reliability indicates the consistency of results when the same instrument is used repeatedly under similar conditions. Data are analyzed using descriptive statistical techniques to measure the overall digital competence level and by variables.

Table 1. Overall Reliability Test Results

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.977	0.979	45

Source: Primary data processed, 2024

Table 2. Per-variable reliability test results

No	Variabel	Cronbach's Alpha	Decision
1	Competence in Hardware and Software Operations	0.921	Reliable
2	Competence in Information and Data Literacy	0.925	Reliable
3	Competence in Communication and Collaboration	0.941	Reliable
4	Competence in Digital Content Creation	0.949	Reliable
5	Competence in Digital Security	0.925	Reliable
6	Competence in Problem Solving	0.957	Reliable
7	Competence in Self-Development	0.897	Reliable

Source: Primary data processed, 2024

After the competency measurement was conducted, the next step was to develop a strategy for improving librarian competency through a qualitative approach with interview data collection methods. Interviews focused on the needs, challenges, and expectations related to the digital competency of librarians who were still below standard. The interview results were transcribed and grouped to map librarian needs to training providers, costs, and available budgets, resulting in priority training activities.

RESULTS AND DISCUSSION

In this study, a survey was conducted to assess various digital competencies of librarians in the academic library of Universitas Negeri Padang. The survey focused on skills related to device operation, data organization, content development, data protection, technical problem-solving, and professional development in digital competencies. This study aimed to evaluate the digital competencies of academic librarians regarding the evolving skills essential in library and information science practices. A total of 26 librarians participated in the survey. In terms of age distribution, the majority of respondents were in the productive age range, with the 45–54 age group being the most represented (n = 11, 42.3%).

Regarding gender, female librarians dominated the sample (n = 16, 61.5%), while male librarians accounted for 10 respondents (38.5%). These results indicated that female librarians significantly outnumbered their male counterparts in the Universitas Negeri Padang Library. The majority of respondents held a bachelor's degree as their highest level of education (n = 18, 69.2%), while only two respondents (7.6%) had a Master's degree. Other respondents were graduates of diploma programs (D3) or high schools/vocational schools (SMA/SMK). In terms of work experience, most librarians (n = 19, 73%) had been employed for more than 10 years, while the remaining respondents (n = 7, 27%) had worked for less than 10 years. These competencies include digital library infrastructure management, digitization policies and standards, cost planning, staff management, evaluation, user training, pedagogy, communication, and digital skills for digital content preservation and creation experience. This indicates that the number of librarians with a bachelor's degree and over 10 years of experience is significantly higher, whereas the number of diploma and master's degree graduates is considerably lower.

Table 3. Research results

Competencies	N	Mean	Std. Deviation
Competencies in Hardware and Software Operations	26	6,74	1,170
Information and Data Literacy Competencies	26	6,32	1,348
Communication and Collaboration Competencies	26	6,47	1,368
Digital Content Creation Competencies	26	5,57	1,692
Digital Security Competencies	26	5,46	1,825
Problem-Solving Competencies	26	5,09	1,891
Self-Development Competencies	26	5,88	1,655

Source: Primary data processed, 2024

One key area assessed in this study was the librarians' ability to operate hardware and software effectively. Survey results indicated strong performance in ensuring internet connectivity (M = 7.08, SD = 1.055) and using hardware such as printers and scanners (M = 6.92, SD = 1.017). This showed that the majority of librarians were able to perform basic operational tasks of technology in the library environment well. However, the ability to solve software problems such as SIPUS (M = 5.96, SD = 1.509) showed considerable variation in skills, with some librarians still at the basic level.

The interview results showed that librarians often called technicians to handle technical problems, such as printers that are not detected or software crashes. This dependency reduced librarians' creativity in solving problems independently. To improve this competency, real-case troubleshooting training is needed that focuses on hardware and software, library software implementation simulations, and more intensive collaboration with library IT staff and the LDTI team (Ariani et al., 2023). Interview results indicated that librarians could use basic computer devices and software such as Microsoft Office, SLiMS, and library management tools. However, some still relied on technicians for installing new applications, configuring settings, or troubleshooting issues. One Informant stated, "If there is a printer or network problem, we usually contact IT directly" (Informant, interviewed, August 20, 2024). This showed that, despite having basic skills, librarians needed to improve their technical independence. A better comprehension of hardware and software functions will help them solve minor problems without assistance. Another essential skill measured was librarians' ability to search, evaluate, and manage digital information. Survey data indicated that librarians were quite skilled in filtering relevant information (M = 6.62, SD = 1.023) and verifying the reliability of information sources (M = 6.35, SD = 1.294). However, skills in using specific search techniques, such as logical operators, were still low (M = 5.81, SD = 1.855). The large variation among respondents suggests that some librarians have mastered these techniques, but others still need to develop. Informants confirmed that librarians often evaluated information only when they had free time due to limited service time. They relied on trusted sources such as ScienceDirect, EBSCO, and ProQuest for the graduate students' academic needs. To improve this competency, advanced information literacy training needs to focus on information evaluation techniques, the use of logical operators, and reference management using software such as Mendeley or Zotero. Academic information search simulations can also help librarians become more confident in meeting user needs (Sa'ari et al., 2024).

Librarians can search for and store information from various online sources. However, their skills in evaluating quality, credibility, and relevance vary widely. Most librarians select articles based on the site's reputation, often without critical evaluation. One informant emphasized, "The important thing is that it is on the internet and the topic" (Informant, interviewed, August 20, 2024). It pointed to a need for improved information literacy training. In addition, they still managed data such as visitor statistics and circulation manually, instead of using digital dashboards effectively. Digital

communication and collaboration were also assessed as part of librarian competencies. The survey results showed that librarians possessed high skills in maintaining digital communication ethics (M = 6.77, SD = 1.177) and considering cultural and age aspects when interacting (M = 6.85, SD = 1.190). However, skills in using digital tools for collaboration, such as Zoom and Google Workspace, were still relatively low (M = 5.96, SD = 1.455). Interview results revealed that although librarians actively use Zoom for meetings and technical assistance, unstable internet connections often disrupt communication and hinder effective collaboration. According to DigComp 2.2 (Ariani et al., 2023; Hammoda & Foli, 2024), digital collaboration includes not only the use of tools but also the ability to engage in team-based tasks, co-create content, and manage shared responsibilities. In this regard, librarians are still in the early stages of mastering collaborative practices beyond basic communication. Librarians frequently use WhatsApp and email, which are more informal and asynchronous. However, they rarely utilize collaborative platforms such as Microsoft Teams, Google Docs, or Slack. From the perspective of Computer-Mediated Communication (CMC) theory (Young et al., 2021), this reflects a preference for low-synchronous communication tools due to perceived simplicity and control. Yet, this limits opportunities for co-creation and rapid decision-making. Security concerns and a lack of clarity in managing shared documents often discourage collaborative editing. As a result, librarians tend to work individually and combine outputs manually, which can reduce efficiency and cross-unit synergy. To enhance digital collaboration competencies, structured training on shared digital workspaces is needed, along with simulations or real–life projects that encourage cross-functional teamwork. Institutions also need to support a culture shift, recognizing collaboration not just as a technical task but as a core component of professional performance in the digital era.

The ability to create, edit, and manage digital content represents another critical competency. The study findings revealed that most librarians operated at a basic to intermediate level in this area (M = 5.19, SD = 1.625). Understanding of copyright and licensing regulations was moderate (M = 5.65, SD = 1.648), while technical skills such as programming or advanced multimedia editing were very low (M = 5.15, SD = 1.567).

Interview data revealed that librarians mostly used simple design tools such as Canva, relying on existing templates to produce static visual content, primarily for personal tasks or administrative communication, rather than proactive library promotion. The lack of confidence in their design skills and uncertainty about digital copyright were among the most frequently cited barriers to content creation. Additionally, there was no structured workflow for digital content planning within the library unit. According to the DigComp 2.2 framework by Ariani et al. (2023), Borbely & Némethi-Takács (2023), and Hammoda & Foli (2024), content creation is not only about technical skills but also about integrating creativity, legal awareness, and communication goals. Librarians are expected to generate content that is accessible, engaging, and aligned with ethical standards. In this study, most librarians still lacked familiarity with

multimedia tools (e.g., video editors, animation software), and few created interactive or participatory content for platforms such as Instagram, TikTok, or YouTube. This finding is in line with the literature on digital creative literacy (Luo & Tang, 2024), which emphasizes the shift from passive information consumption to active knowledge production in digital environments. Current library social media content tends to be one-way and informative, not yet participatory or interactive. This contradicts best practices in digital engagement, which encourage user interaction and community-building. Librarians, as digital information facilitators, need to be equipped not only with basic graphic design skills but also with strategic digital storytelling capabilities. To improve this digital content creation competency, institutions should provide targeted training in both the technical and creative aspects of digital content production. Training topics can include graphic design, basic video editing, use of infographics, copyright and creative commons licensing, and social media management (Dwivedi et al., 2021; Nabila et al., 2022; Nabila & Erlianti, 2021). Furthermore, librarians can be introduced to design thinking approaches to develop more user-centered and goal-oriented content. Empowering librarians to manage digital content confidently will enhance their role as communicators, educators, and promoters in the digital library landscape.

In terms of digital security, the study highlighted moderate levels of awareness and practice among librarians. Survey results showed that librarians' digital security skills were moderate (M = 5.46, SD = 1.825), with notable differences among individuals. Some librarians practiced basic digital safety measures, while others were unsure about managing digital risks. Interview data supported these findings. Some librarians reported limited knowledge of secure password practices, data encryption, and safe internet browsing. Confusion also existed around using antivirus software and institutional policies for sensitive information. While some staff were aware of phishing threats and the need for regular system updates, their application of these practices varied.

Additionally, not all librarians regularly update their passwords, use multi-factor authentication, or verify the legitimacy of digital links or emails. These inconsistencies jeopardize their personal information and the security of library databases and user data. To fill these gaps, structured digital security training is urgently needed. The training should include practical sessions on recognizing online threats, managing digital identities, and using cloud services safely. Clear institutional guidelines on cybersecurity and regular audits or simulations could also promote a culture of digital responsibility in the library. In today's digital library landscape, enhancing librarians' digital security skills is crucial. It protects users and the institution from the ever-evolving cyber risks (Aslam, 2019). Librarians understand the importance of data security, especially in safeguarding library accounts and user information. However, broader digital security practices, such as two-factor authentication, access permission management, and phishing detection, are not commonly applied. Some librarians still use the same password for multiple accounts for fear of forgetting it. This highlights the gap in understanding and

practicing everyday digital security. Education about privacy and personal data protection is vital, given that librarians handle sensitive student and faculty data.

The ability to identify technological needs and resolve technical problems remains underdeveloped among librarians. The survey results showed that librarians' ability to handle technical problems (M = 5.19, SD = 2.173) and identify new technological needs (M = 5.04, SD = 1.865) was at a low level, with quite large variations. Interviews confirmed that librarians often only took initial steps, such as restarting the device when a problem occurred, before handing the problem over to a technician. However, there was an initiative from librarians to develop a mobile application for book lending services. To improve this competency, digital innovation training needs to be executed to strengthen librarians' abilities to create efficient technological solutions. Librarians' skill to create digital content for promotion and education is limited. They mostly create simple posters using Canva and rely on templates. Only a few can create interactive videos, animations, or infographics. Library social media often shares one-way information, lacking interactivity. Many librarians feel unsure about creating content because they lack design skills. However, in the digital age, librarians should share engaging visual information. Training in digital content creation is urgently needed, focusing on both technical and creative aspects (Ariani et al., 2023; Zhang, 2021).

The final area explored was librarians' engagement in self-directed digital skill development. Survey results indicated a strong motivation among librarians to improve skills (M = 6.77, SD = 1.478). However, their practice in self-assessing digital skills was limited (M = 5.42, SD = 1.677). This gap showed a positive attitude toward learning but a lack of effective strategies for measuring digital literacy growth. Interviews confirmed this perspective. Many librarians wanted to boost their digital skills to provide quality services and stay relevant in the digital library world. However, they faced time constraints, limited support, and unclear guidance. Some mentioned that heavy workloads and daily responsibilities hindered their ability to learn new tools or explore new technologies. This reliance on formal training meant self-directed learning often took a backseat.

While some librarians attend webinars or watch YouTube tutorials, most do not enroll in structured programs such as professional certifications or digital assessments unless required. Self-reflection and evaluating digital competencies are rarely part of their routine. This highlights the need for metacognitive strategies such as goal setting, progress tracking, and reflective practice to strengthen these skill areas. To support ongoing self-development, institutions should create a more encouraging learning environment. They can offer free access to platforms such as Coursera, Udemy, or Skillshare, provide dedicated work time for learning, and recognize efforts with awards or certification incentives. Mentorship programs or peer-learning initiatives can also help librarians engage in ongoing professional development, reducing feelings of isolation and uncertainty. (Lorenzetti et al., 2018).

Moreover, providing self-assessment tools—such as digital competence checklists or skill-tracking apps—could

help librarians track their progress. Institutions might consider integrating personal development goals into performance reviews, fostering a culture of lifelong learning as part of their professional identity. Ultimately, enhancing this competency means improving individual digital skills and nurturing a mindset of curiosity, adaptability, and self-efficacy. These traits are vital for navigating the ever-changing digital information landscape.

CONCLUSION

This study concludes that while librarians at Universitas Negeri Padang have strong foundational digital competencies, such as operating devices, maintaining internet connectivity, and communicating ethically online, they still face significant challenges in more advanced areas, particularly technical troubleshooting, creative content creation, and cybersecurity. In relation to the first research question, the findings show that librarians excel in basic operational tasks but require enhancement of advanced digital skills, including problem-solving, digital innovation, and security practices. In addressing the second research question, the study recommends targeted strategies such as real-case troubleshooting training, advanced information literacy programs focusing on Boolean operators and reference-management tools like Mendeley and Zotero, as well as digital content creation workshops. Better infrastructure, increased access to digital tools, and stronger collaboration with IT personnel should support these efforts. However, this study is limited to librarians at a single institution, which may restrict the generalizability of the findings. Future research should involve multiple institutions and regions, and consider combining self-assessment with direct digital skill evaluations to gain deeper insight into librarians' digital competencies and development needs.

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