RESEARCH PAPER

From Digital Exclusion to Empowerment: Exploring Digital Literacy among Rural Women

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Received: 25th Aug, 2026 | Revised: 1st Sep, 2026 | Accepted: 5th Sep, 2026 | Available Online: 11th Sep, 2026

Abstract
Digital transformation is affording fresh opportunities for socioeconomic participation; yet, rural women continue to suffer inequalities in access and in the meaningful use of digital technologies. This paper explores the status of digital literacy and inclusion of rural women in India and the relationship between digital literacy and educational, financial, economic and household empowerment indicators. A cross-sectional research design with secondary data from the National Family Health Survey-5 (NFHS-5) 2019-2021 was used. Descriptive statistics, rural/urban comparison, correlation analysis, and multiple regression were used. Results showed a wide internet gap as the average use of the internet in the rural area among women was 33.68% while it was 56.21% in the urban area. Personal mobile-phone access, literacy, and educational attainment also were lower among rural women. Significant inter-state and Union Territory differences in internet use were found. Personal mobile-phone access, literacy and 10+ years of schooling were strongly and positively correlated with internet use. In the multivariate model, mobile-phone access continued to be a major factor associated with internet use. Internet use also had a positive correlation with participation in household decision making but was not significantly related to paid work, property ownership or individual use of a bank account. The results show that access to digital technology is not enough to bring about socioeconomic empowerment. Integrated interventions of affordable technology, education, digital skills, financial capability and meaningful socio-economic participation are necessary for effective digital empowerment of rural women.

Keywords: Digital literacy; Digital exclusion; Rural women; Women empowerment; Digital inclusion
How to cite this article: Shilpa P1 Dr. Someshekar P2. From Digital Exclusion to Empowerment: Exploring Digital Literacy among Rural Women. Int J Drug Deliv Technol. 2026;16(82s):1154-1162. DOI: 10.25258/ijddt.16.82s.127.

1. Introduction

Digital technologies are also more and more integrated in educational, financial, employment, communication, healthcare, governance and access to public information. But the gains of digital transformation are not equal and are still not reaching those who are socially and geographically excluded. The idea of the digital divide has thus expanded to include digital skills, the ability to use the technology meaningfully, and the ability to leverage technology for socioeconomic opportunities (Aryal, 2024). In this context, women are at a specific disadvantage due to unequal access and affordability, a lack of confidence in technology, and low levels of social autonomy and education. Digital literacy is thus seen as a valuable tool to address gender disparities and improve women's role in sustainable development (Aslam et al., 2024). Women's digital exclusion is multi-dimensional and is a result of socioeconomic, educational, geographical and gender-related limitations. A comprehensive study on digital exclusion of women reveals that there are still some challenges that hinder women from gaining equal access and benefit from digital technologies (Gupta & Kiran, 2025). Such inequalities are significant in rural areas, where infrastructural constraints and social and economic factors can exacerbate gender constraints. Rural digital exclusion has been linked to issues related to connectivity, technological infrastructure, cost, access, and/or digital proficiency (Mwansa et al., 2025). Likewise, the digitalization journey of young rural women shows that geographical context remains influential in the opportunities for meaningful engagement with new technologies (Lendzhova, 2025). These inequalities indicate that digital inclusion through technology is not necessarily possible.

Gender is an important element in the digital divide as unequal access to ICTs can lead to a reinforcement of inequalities in society and economics instead of eradicating it. Female empowerment can be achieved by empowering them with ICT skills which can help in bridging the digital divide between men and women (Hendricks & Olawale, 2022). Recent systematic evidence also indicates that the inclusion of women in digital spaces is limited and that there are interdependent and gendered challenges that need to be investigated in greater detail, as there is still a need to better understand the mechanisms of digital inequality

(Singh et al., 2025). The gender digital divide in an increasingly connected society is also worrying, as it exposes the risk of women being further marginalised as key services and economic and social activities shift to digital platforms (Tripathi, 2026). Studies that focus on digital literacy for women also highlight the significance of the digital divide for women as a vital aspect of gender inequality in today's world (Tripathi, 2025).

Digital literacy, however, has significant potential to shift women from being out of the picture to autonomous and active. With regards to marginalised women evidence shows that access to ICTs can lead to opportunities for empowerment if it is also coupled with the capacity to engage with digital spaces meaningfully (Pei et al., 2024). Studies on adolescent girls in LMICs similarly show an increasing interest in research to see if digital literacy can help to empower gender-disadvantaged groups (Meherali et al., 2021). At a larger scale, women empowerment through digital literacy has become a considerable interdisciplinary research field as there is increased attention on how technology capacities relate to women empowerment (Pratama et al., 2026). Digital exclusion should therefore not only be interpreted as a lack of technology, but also as a potential limitation for women's social and economic engagement. This is particularly true for women who are at social and geographical margins, where the notions of exclusion and empowerment are also tied to other forms of structural inequalities (Arshad, 2026).

Given this context, the current study explores the issue of digital literacy and inclusion of rural women, specifically considering the use of the internet, access to personal mobile phones, education, and measures of socioeconomic empowerment. It aims to offer empirical data on the potential links between the shift from digital exclusion to digital meaningful inclusion and the enhancement of opportunities and agency of rural women, through drawing out the connections between digital participation and other facets of women's empowerment.

Research Objectives:

- To assess the level of digital inclusion among rural women through indicators of internet use and personal mobile-phone access.
- To examine rural–urban disparities in women's digital inclusion and investigate the relationship between educational attainment and digital participation.
- To analyse the association between women's digital inclusion and broader indicators of financial, economic, and household empowerment.

2. Methodology

2.1 Research Design

The study used a quantitative cross sectional secondary data research design to investigate digital literacy and inclusion of rural women and their association with socioeconomic empowerment. This was a quantitative approach due to the use of measurable indicators such as internet use, mobile-phone access, education, financial participation, employment, asset ownership and household decision-making. Most of the observations were carried out in rural areas and on urban areas for comparative analysis, in both cases focusing on women.

2.2 Data Source and Study Population

Secondary data from the National Family Health Survey-5 (NFHS-5) 2019-2021 from Indian states and Union territories were used for the study (Singhal, 2022). Data includes rural and urban level information on demographic indicators, educational indicators, digital-access indicators, socioeconomic indicators, and women empowerment indicators. The analysis was largely carried out using the data for females aged 15-49 years, and thus reflecting the population covered by the main female-specific digital and education indicators.

2.3 Study Variables

Digital inclusion was mainly assessed based on the percentage of women aged 15-49 who have ever accessed the internet, and digital access was measured by the percentage of women owning a mobile phone that they use. The indicators were applicable proxies for digital literacy and engagement. Educational characteristics were women's literacy and 10 or more years of education. Women empowerment was explored as a multi-faceted issue. The indicators of financial empowerment were access to a bank and/or savings account used by the women, and the indicators of economic empowerment were being involved in paid work. Women's asset empowerment was assessed by their owning a house and/or land, individually and/or jointly. Currently married women's involvement in making major household decisions indicated household agency. Geographical disparities were investigated by examining rural/urban residence.

2.4 Data Preparation

Data was reviewed for completeness and consistency, missing observations and variable definitions prior to analysis. Variables pertinent to the goals of the study were chosen and categorized by geographical unit and by rural – urban residence.

To keep percentage variables comparable, they were kept in their original form. Data for days with missing observations were excluded and not estimated. Interpretation of indicators related to various female populations such as all women aged 15–49 years and currently married women were made in line with the definitions used in the original indicators.

2.5 Statistical Analysis

The women's internet usage, mobile-phone access, education and empowerment indicators were summarized using descriptive statistics such as the mean, standard deviation, minimum and maximum. Rural–urban comparisons were conducted to determine geographical differences in digital inclusion. The correlation analysis has been performed to explore the association between internet use and literacy, education, availability of mobile phones, financial inclusion, paid employment, property ownership, and household decision making. Several variables were also included to assess the relationships between digital inclusion and selected educational and empowerment indicators in the context of multiple regression analysis. $P < 0.05$ was used as the criterion for statistical significance. Given that the study was based on cross-sectional secondary data, statistical relationships were interpreted as association not causality.

2.6 Analytical Considerations and Ethical Aspects

While internet use and access to own mobile phones offer valuable indicators of digital participation, they are not a full representation of digital literacy, as this also includes online safety, information evaluation, content creation and higher-level digital competencies. The results were thus mainly understood from a digital inclusion and engagement perspective. In addition, the information about aggregates was not assumed to depict individual-level causal relationships. The study only used secondary and aggregated survey data and did not directly involve humans. No personally identifiable information was used, and data was only analysed for academic research purposes.

3. Results

The data uploaded for the analysis showed significant disparities in digital inclusion in rural women in different states and union territories of India. Descriptive statistics, rural/urban comparisons, geographical variations, correlation analysis, and multivariate regression are used to present the results. Negative values for indicators, which are necessarily percentages, were coded as unobserved values. Hence the number of observations for each analysis is somewhat different.

3.1 Descriptive Profile of Digital Inclusion and Empowerment among Rural Women

The key indicators for rural women are provided in Table 1. Of the valid geographical observations, the average share of women in the rural population aged 15–49 years who had ever used the internet was 33.68% while the share of women with a mobile phone they used was 58.11%. The average female literacy rate was 76.60% and the average of women with at least 10 years of education was significantly lower at 40.31%. Financial inclusion was relatively high with 79.34% of rural women having a bank or savings account that they had access to. The participation in household decision-making also had a high mean of 89.90%. By contrast 28.68 per cent of women were employed in the 12 months leading up to the survey and were paid in cash. These data show that women's use of digital platforms, especially the internet, was still significantly lower when compared with several traditional measures of women's socio-economic participation (Table 1).

Table 1. Descriptive Statistics for Selected Indicators among Rural Women

Indicator	N	Mean (%)	SD	Minimum (%)	Maximum (%)
Ever used the internet	34	33.68	13.35	13.98	68.28
Personally used mobile phone	34	58.11	14.33	31.44	87.06
Literate	36	76.60	9.49	54.54	97.47
≥10 years of schooling	36	40.31	13.11	17.89	75.29
Participate in household	34	89.90	5.07	80.27	99.82

d decisions					
Worked and paid in cash	34	28.68	10.68	12.80	55.54
Own house and/or land	34	45.48	14.27	17.28	74.46
Personally use bank/savings account	34	79.34	9.50	55.41	96.72

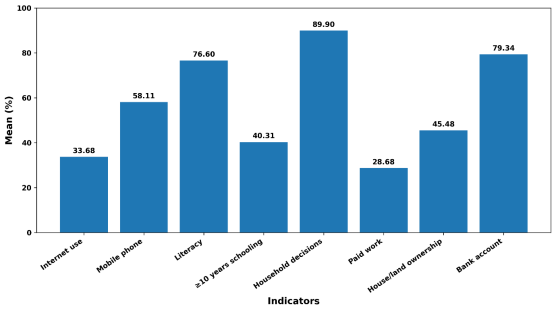

Figure 1. Mean Levels of Major Digital, Educational, and Empowerment Indicators among Rural Women

The pattern illustrated in Figure 1 would show internet use as one of the lowest-performing indicators, at 33.68%, compared with mobile-phone access (58.11%), literacy (76.60%), financial inclusion (79.34%), and household decision-making participation (89.90%). The gap between mobile-phone access and internet use is particularly noteworthy, suggesting that access to a mobile device does not necessarily translate into active internet participation (Figure 1).

3.2 Rural–Urban Differences in Women's Digital Inclusion

The main digital and education indicators showed significant differences between the rural and urban areas. Average internet use was 33.68% for rural women and 56.21% for urban women; the difference was 22.53 percentage points as presented in Table 2. This difference was statistically significant ($t = 17.57$, $p < .001$). Rural women (58.11%) also did not use mobile phones for personal communication significantly as much as urban women (74.99%) ($p < .001$). There were differences in education following a similar pattern. The urban population had a higher rate of female literacy (+10.51 percentage points), and female education of 10 or more years (+17.80 percentage points). Both differences were statistically significant ($p< .001$). The use of bank-accounts was also significantly higher among urban women with a relatively modest difference of 2.63 percentage-point ($p = .019$). On the other hand, rural women had higher frequency of owning house and/or land than urban women (Table 2).

Table 2. Rural–Urban Comparison of Digital, Educational, and Empowerment Indicators

Indicator	**Rural Mean (%)**	**Urban Mean (%)**	**Urban–Rural Difference**	***t***	***p***
Internet use	33.68	56.21	22.53	17.57	<.001
Personal mobile-phone use	58.11	74.99	16.88	11.12	<.001
Literacy	76.60	87.11	10.51	8.84	<.001
≥10 years schooling	40.31	58.10	17.80	12.03	<.001
Household decision-making	90.07	92.00	1.92	2.88	.007
Paid work	28.68	26.90	−1.78	−1.14	.262
House/land ownership	45.48	39.88	−5.61	−5.54	<.001
Bank/savings	79.34	81.97	2.63	2.46	.019

account use					

The rural–urban digital divide is particularly evident in Figure 2, where the differences in internet use, mobile-phone access, literacy, and extended schooling consistently favour urban women. The largest gap was observed for internet use, reinforcing the central premise that geographical location remains an important dimension of women's digital exclusion (Figure 2).

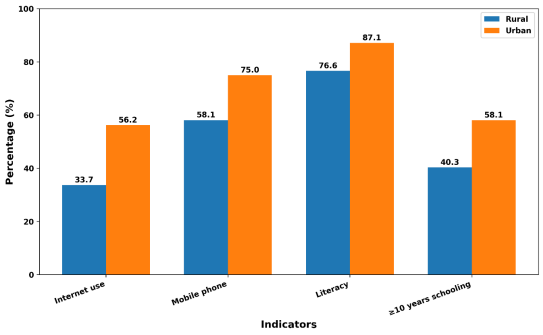

Figure 2. Rural–Urban Comparison of Women's Internet Use, Mobile-Phone Access, Literacy, and Schooling

3.3 Geographical Variation in Rural Women's Internet Use

Significant differences across states were found for rural women's internet use. This proportion was found to be the highest in Goa (68.28%) and the second highest in Sikkim (68.08%) as seen from Table 3. Kerala (57.54%), Ladakh (53.98%) and Puducherry (50.37%) had relatively high levels. On the other hand, the lowest valid proportion of rural women ever using the internet was found in West Bengal (13.98%), Andhra Pradesh (15.35%), Telangana (15.78%), Bihar (17.00%) and Gujarat (17.53%).

Table 3. Highest and Lowest Levels of Internet Use among Rural Women

Rank	Highest State/UT	Internet Use (%)	Lowest State/UT	Internet Use (%)
1	Goa	68.28	West Bengal	13.98
2	Sikkim	68.08	Andhra Pradesh	15.35
3	Kerala	57.54	Telangana	15.78
4	Ladakh	53.98	Bihar	17.00
5	Puducherry	50.37	Gujarat	17.53

The geographical distribution displayed in Figure 3 therefore indicates pronounced spatial inequality in digital participation. The difference between the highest and lowest valid values exceeded 54 percentage points, demonstrating that rural women's digital inclusion is far from uniform across India (Figure 3).

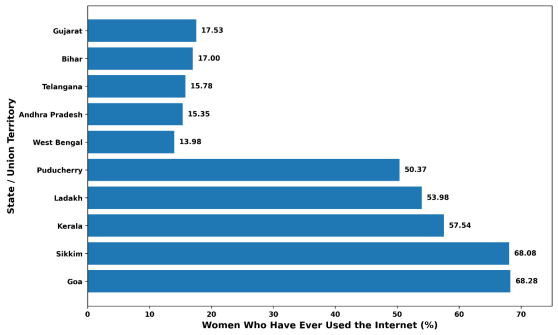

Figure 3. Interstate Variation in Internet Use among Rural Women

3.4 Relationship between Digital Inclusion, Education, and Empowerment

Pearson correlation analysis was used to find the correlation between internet use of rural women and digital access, education, and empowerment indicators. Personal mobile-phone access was most strongly correlated with internet use ($r = .819$, $p < .001$) as reported in Table 4. Women's literacy ($r = .731$, $p < .001$) and having 10 or more years of schooling ($r = .741$, $p < .001$) also had good positive correlation with internet use. There was a moderate positive correlation between participation in decision making in the household and internet use ($r = .428$, $p = .012$). However, internet use was not significantly associated with paid work ($r = -.113$, $p = .523$), house/land ownership ($r = -.057$, $p = .748$), or personal bank-account use ($r = .195$, $p = .268$). Thus, a stronger case is made by the results for the link between education, individual access to technology, and digital participation, than for the general relationship between internet access and all aspects of socioeconomic empowerment (Table 4).

Table 4. Correlations between Rural Women's Internet Use and Selected Indicators

Variable	Pearson's *r*	*p*	Interpretation
Personal mobile-phone use	.819	<.001	Strong positive
Literacy	.731	<.001	Strong positive
≥10 years schooling	.741	<.001	Strong positive
Household decision-making	.428	.012	Moderate positive
Paid work	−.113	.523	Not significant
House/land ownership	−.057	.748	Not significant
Bank/savings account use	.195	.268	Not significant

The strong positive relationship between mobile-phone access and internet use is visualized in Figure 4. Geographical units characterized by greater personal mobile-phone access among rural women generally recorded substantially higher internet use. Similar positive patterns were observed for literacy and educational attainment (Figure 4).

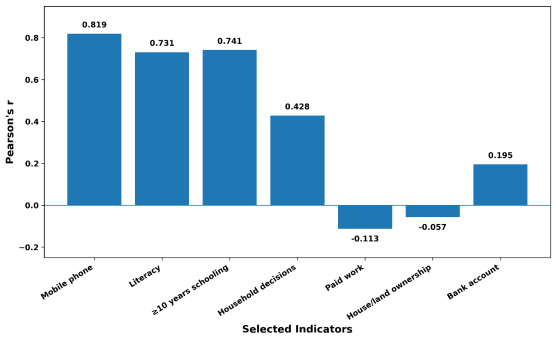

Figure 4. Relationship between Personal Mobile-Phone Access and Internet Use among Rural Women

3.5 Predictors of Internet Use among Rural Women

A multiple linear regression model was estimated to investigate if geographical variation in the use of the internet by rural women could be explained by literacy, educational attainment, and personal mobile-phone access. The overall model was statistically significant, $F(3, 30) = 27.56$, $p < .001$, accounting for about 73.4% of the variance in internet use ($R^2 = .734$, adjusted $R^2 = .707$) as presented in Table 5. Personal mobile-phone access was also a statistically significant predictor of internet use, after the three predictors were considered ($B = 0.460$, $p = .002$). Thus, after controlling for literacy and schooling, a one percentage-point rise in women's use of a mobile phone was related to a roughly 0.46 percentage-point rise in women's internet use. Multivariate analysis (Table 5) showed that neither literacy ($B = 0.234$, $p = .292$) nor 10 or more years of schooling ($B = 0.298$, $p = .073$) was statistically significant alone.

Table 5. Multiple Regression Predicting Internet Use among Rural Women

Predictor	B	SE	*t*	*p*	95% CI
Constant	−22.241	11.437	−1.945	.061	−45.599, 1.117
Literacy	0.234	0.218	1.072	.292	−0.212, 0.680
≥10 years schooling	0.298	0.160	1.859	.073	−0.029, 0.624
Personal mobile-phone use	0.460	0.139	3.300	.002	0.175, 0.744

Model statistics: $N = 34$; $R^2 = .734$; Adjusted $R^2 = .707$; $F(3,30) = 27.56$; $p < .001$.

The overall results indicate a significant rural-urban gap, significant inter-state differences, and high correlations between digital participation, mobile phone access, and educational factors for rural women. Meanwhile, the lack of meaningful relationships with several economic and asset-based measures shows that digital participation does not necessarily equal socioeconomic empowerment.

Instead, the findings indicate that the trajectory towards digital exclusion and empowerment is multi-dimensional, and the personal experience with digital technology appears to be a key part of women's access to the internet.

4. Discussion

The results indicate a significant rural-urban divide in internet use and in having their own mobile phone with rural women reporting much lower levels of access to these than urban women. The average usage of internet in rural and urban areas among women was 33.68% and 56.21% respectively and there was significant difference in personal mobile-phone usage as well. The results confirm the fact that digital exclusion is still a significant limitation in women's involvement in rural communities. Digital literacy is also found to be a crucial enabler for rural women to gain access to information and improve their socioeconomic opportunities in previous studies (Kumar et al., 2026). Empowerment is also thought to be supported by digital literacy due to evidence from rural communities indicating that digital literacy helps individuals be more effective in an environment that is increasingly mediated by digital technologies (Prastiwi et al., 2025).

The findings also showed significant geographical disparities in the rural women's internet usage with the percentage varying from about 14% to over 68% in the states and UTs observed. This multiplicity indicates the lack of uniformity in rural women with respect to digital inclusion and implies that they can be viewed as a heterogeneous group. These geographical differences may be due to the difference in infrastructure, education, socioeconomic situation and technological accessibility. The importance of digital-literacy programmes to engage marginalised populations in digital spaces is also highlighted by the presence of similar evidence (Prasastiningtyas et al., 2024). The availability of ICT has also been identified as a key factor in empowering women in the Indian context, but this needs to be complemented with opportunities to acquire meaningful digital skills (Debbarma & Chinnadurai, 2023). More inclusive participation in new technological and economic opportunities through the strengthening of digital literacy is also reflected on broader evidence on rural development.

An important correlate of digital participation was education. Internet use showed a strong, positive correlation with women's literacy, and the number of years of schooling completed (ten or more years). This aligns with the evidence that digital literacy is linked to educational empowerment for rural women as educational opportunities can contribute to women's ability to interact with digital technology (Karmaker & Cvetković, 2025). However, there was a stronger association between personal mobile-phone access and Internet use, and it was also statistically significant in the multivariate model. Informal learning opportunities using smart phones can give rural women a chance to develop their digital skills slowly over time (Gautam & Rai, 2025). This can mean that digital literacy can serve as a stepping stone towards socioeconomic engagement for rural women in terms of access to technology (Dayanand et al., 2024).

The links between digital inclusion and empowerment were more complex. The internet use positively and significantly associated with women participation in household decision making, thus it was found that internet use could be related to higher level of participation and agency among women. The study on rural women's digital literacy has also shown that it has a positive impact on their participation, for example, by increasing their self-confidence and trust of institutions (Bai & Yang, 2025). Research on the empowerment of rural, marginalised women also shows that digital and social media can also generate opportunities for empowerment and exacerbate existing inequalities in society (Ram & Yadav, 2026). Digital literacy thus needs to be seen as a facilitator and not as an empowerment precondition (Sharma, 2024).

More important, there were no significant relationships between internet use and paid work, ownership of property and having a personal bank account. This discovery suggests that, at least, the presence of technology participation by itself does not necessarily lead to the elimination of structural economic inequalities. Whilst there are potentially significant contributions of digital literacy in inclusive economic empowerment, the impact of these benefits is constrained by the broader socioeconomic context in which digital technologies are leveraged (MOSOBALAJE et al., 2024). Specifically, digital literacy and its connection with financial literacy and financial empowerment can be influenced by real-world challenges that rural women may face in turning digital skills into financial empowerment (Sumitha & Wright, 2026). Mobile technologies can play a role in social inclusion in rural contexts, but this role must be more than access and provide access to meaningful services and opportunities (Ye & Yang, 2020).

From a holistic perspective, the results indicate that rural women's empowerment from digital exclusion to inclusion is a multifaceted phenomenon that needs to be tackled with a holistic approach, associating the access to information technologies, education, digital skills, financial empowerment and

opportunities for meaningful socioeconomic participation.

5. Conclusion

The current study explored the issue of digital literacy and inclusion of rural women with a focus on how to move from digital exclusion to socioeconomic empowerment. The results show there is huge rural–urban digital divide, as rural women report much lower internet use, personal mobile phone ownership, literacy and educational achievement than their urban counterparts. Geographic differences further suggest that there are heterodoxly distributed opportunities for digital participation in India. Education became an important factor related to digital inclusion, and the personal use of mobile phone was the one that showed the higher association with internet use and was a significant one in the multivariate analysis. The results also show that digital inclusion is not necessarily and automatically synonymous with socioeconomic empowerment. While there was a positive association between internet use and women's participation in decision making in the household, there were no significant relationships with paid work, owning property or using a bank account independently. Digital empowerment is therefore a multidimensional process that involves technological access, but also education, financial capacity, and economic opportunities and women's agency. Interventions to bridge the digital divide among rural women thus need to be more than just internet connectivity. Policies should focus on lower cost personal digital devices, easily available Internet infrastructure, context-based digital-literacy training, financial literacy, and educational opportunities. A combination of efforts to strengthen these interrelated aspects can help rural women transcend simple access to technologies to achieving digital participation, autonomy, and sustainable socioeconomic empowerment.

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