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Organizational resource perception and teachers' digital competence in higher education: The mediating role of teacher agency

Kang Huo[1], Peng-Fei Chen[2*]
[1,2]Department of Education Management, Chinese International College Dhurakij Pundit University, Thailand; 410455793@qq.com (K.H.) blissfulalice@gmail.com (P.F.C.).

Abstract: With the rapid development of educational informatization, teachers' digital competence in higher education has become a crucial capacity for advancing teaching innovation and educational reform. This study aims to examine how university teachers' perceptions of organizational resources influence their digital competence, with particular emphasis on the mediating role of teacher agency. A quantitative cross-sectional survey was conducted with 813 valid responses from teachers in five universities in Shanxi Province, China. Regression and mediation analyses were performed using the PROCESS macro for SPSS, controlling for gender and age. The results indicate that perceptions of organizational resources significantly and positively predict teachers' digital competence, and teacher agency partially mediates this relationship, with resources exerting both direct and indirect effects through enhanced self-efficacy and proactive engagement. These findings underscore the importance of supportive institutional resources and proactive teacher agency in fostering digital competence. This study contributes theoretically by extending teacher agency research within technology integration and provides practical implications for universities seeking to strengthen training, infrastructure, and motivational support.

Keywords: *Chinese higher education, Organizational resource perception, Teacher agency, Teachers' digital competence.*

1. Introduction

The rapid advancement of digital education has made teachers' digital competence in higher education a critical capacity for advancing educational innovation and teaching reform [1]. Digital competence not only encompasses teachers' abilities to access, process, and apply information, but is also closely associated with the effectiveness of instructional design and implementation, thereby constituting a key component of teachers' professional development [2]. Within the context of informatization, the level of teachers' digital competence directly influences the overall quality of education and student learning outcomes [3].

Organizational resources in higher education refer to the variety of resources provided by universities to achieve educational, research, and service objectives, including human, material, financial, and informational resources [4]. A positive perception of these resources can motivate teachers to actively utilize them, thereby enhancing their digital competence [5]. However, the effective utilization of organizational resources also depends on teachers' agency. Teacher agency reflects teachers' initiative, adaptability, and innovativeness in educational practice, which determine whether external resources can be transformed into tangible improvements in professional capacity [6, 7].

Existing studies suggest that demographic factors such as gender and age may influence teachers' digital competence. For example, younger teachers are often more receptive to new technologies, while gender differences may shape patterns of technology adoption and application [8, 9]. Therefore, when examining the relationship between organizational resource perception and teachers' digital competence, it is important to control for gender and age.

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* Correspondence: blissfulalice@gmail.com

This study focuses on university teachers in Shanxi Province, China, with the objective of exploring the impact of organizational resource perception on teachers' digital competence and examining the mediating role of teacher agency. By analyzing 813 valid survey responses, the study seeks to reveal the underlying mechanisms linking organizational resource perception and teachers' digital competence, thereby providing theoretical insights and practical implications for promoting teachers' professional development in higher education.

2. Literature Review

With the rapid development of educational informatization and artificial intelligence technologies, teachers' digital competence in higher education has become a key capacity for improving teaching quality and fostering educational innovation. To further examine the factors influencing teachers' digital competence, this study constructs a research framework grounded in the Technology Acceptance Model (TAM) and the Technological Pedagogical Content Knowledge (TPACK) framework. The framework focuses on the influence of organizational resource perception, teacher agency, and demographic variables such as gender and age on teachers' digital competence.

The literature review is structured into three sections: (1) the theoretical foundations, (2) prior research on the core variables, and (3) the interrelationships among these variables. Based on this review, the research hypotheses of the present study are proposed.

2.1. Theoretical Foundations

This study draws on the Technology Acceptance Model (TAM) and the Technological Pedagogical Content Knowledge (TPACK) framework. TAM posits that external variables influence individuals' technology use through their perceptions of usefulness and ease of use [10, 11]. In the context of higher education, organizational resources-such as training, equipment, and service support-can serve as external factors that facilitate the development of teachers' digital competence [12, 13].

TPACK, on the other hand, emphasizes the integration of technology, pedagogy, and content knowledge as essential for effective teaching [14, 15]. Within this framework, teacher agency functions as a critical mediating mechanism, enabling the transformation of organizational resources and professional knowledge into practical teaching competence [16].

Taken together, TAM and TPACK highlight the logical connections among organizational resource perception, teacher agency, and digital competence, thereby providing a strong theoretical foundation for the research hypotheses of this study.

2.2. Studies on Organizational Resource Perception and Teachers' Digital Competence

A review of the existing literature indicates that teachers' perceptions of organizational resources constitute a key determinant of their digital competence [17]. When teachers perceive adequate access to technological equipment, training opportunities, and service support, they are more likely to strengthen their ability to apply information technologies and improve digital teaching practices [18].

Moreover, demographic factors such as gender and age also affect teachers' perceptions of organizational resources and their digital competence. For instance, younger teachers typically demonstrate greater adaptability to new technologies and more effective resource utilization, whereas male teachers often report higher confidence in using technology [19, 20].

Based on these insights, the following hypotheses are proposed:

H_1: There are significant differences in organizational resource perception among university teachers in Shanxi, China, across gender and age groups.

H_2: There are significant differences in digital competence among university teachers in Shanxi, China, across gender and age groups.

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2.3. Studies on Teacher Agency

Teacher agency refers to the capacity and willingness of teachers to proactively plan, mobilize resources, and adjust strategies in order to achieve instructional goals [21]. Research has shown that teachers with higher levels of agency are more likely to engage in self-directed learning and adopt innovative technologies, thereby transforming technological capabilities into practical teaching practices and improvements in digital competence [22].

Demographic factors such as gender and age may also influence teacher agency. For example, younger teachers generally display stronger motivation for learning and greater adaptability to technology, whereas male teachers often report higher confidence in technology use, which may foster more pronounced expressions of agency in teaching practice [19].

Based on these findings, the following hypothesis is proposed:

H_3: There are significant differences in teacher agency among university teachers in Shanxi, China, across gender and age groups.

2.4. Studies on Organizational Resource Perception, Teacher Agency, and Teachers' Digital Competence

The existing literature suggests that organizational resource perception not only directly influences teachers' digital competence but may also exert an indirect influence through the mediating role of teacher agency [17]. When teachers perceive sufficient organizational resources and simultaneously demonstrate high levels of agency, they are more likely to proactively explore, integrate, and apply digital technologies, thereby enhancing their overall digital competence [21]. This mechanism provides a strong theoretical basis for positioning teacher agency as a mediating variable in this study.

Accordingly, the following hypotheses are proposed:

H_4: Organizational resource perception has a significant positive effect on teachers' digital competence among university teachers in Shanxi, China.

H_5: Teacher agency mediates the relationship between organizational resource perception and teachers' digital competence among university teachers in Shanxi, China.

In summary, previous studies have demonstrated that teachers' digital competence in higher education is shaped by multiple factors, particularly organizational resource perception and teacher agency. As a key channel through which teachers gain access to technological equipment, training opportunities, and service support, organizational resource perception can directly promote the enhancement of teachers' digital competence [17, 18]. At the same time, teacher agency-as a core capacity for proactive learning, self-efficacy, and innovative teaching practice-functions as a mediator in this relationship, enabling teachers to more effectively transform resource advantages into tangible digital competence [21, 22].

In addition, demographic factors such as gender and age play a notable role in shaping teachers' perceptions of organizational resources, their agency, and their digital competence. Empirical studies have shown that younger teachers and male teachers often display stronger adaptability to digital technologies and higher confidence in technology use [19, 20].

Building on these insights, this study hypothesizes that organizational resource perception has a direct positive effect on teachers' digital competence, while teacher agency mediates this relationship. Furthermore, gender and age are considered as important background variables influencing these constructs. Accordingly, the present study aims to test both the direct and mediated effects while also analyzing group differences, thereby providing a more comprehensive understanding of the mechanisms that underlie the development of teachers' digital competence in higher education.

3. Research Methodology and Design

3.1. Research Framework

Grounded in the Technology Acceptance Model (TAM) and the Technological Pedagogical Content Knowledge (TPACK) framework, this study proposes a conceptual model to examine the mechanisms through which organizational resource perception influences teachers' digital competence

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in higher education. Specifically, it is hypothesized that organizational resource perception exerts a direct positive effect on teachers' digital competence, while also exerting an indirect effect through the mediating role of teacher agency.

To empirically validate this framework, regression and mediation analyses were employed to test both the direct and indirect pathways. The hypothesized research model is presented in Figure 1.

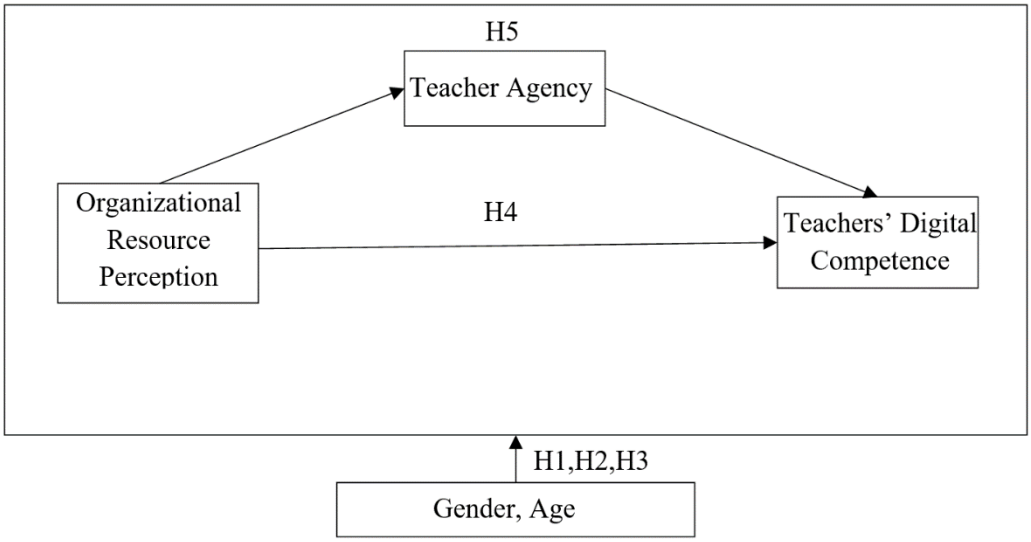

Figure 1.
Research Framework.

3.2. Research Hypotheses

Based on the literature review, theoretical foundations, and research objectives, this study proposes the following hypotheses:

H_1: There are significant differences in organizational resource perception among university teachers in Shanxi, China, across gender and age groups.

H_2: There are significant differences in digital competence among university teachers in Shanxi, China, across gender and age groups.

H_3: There are significant differences in teacher agency among university teachers in Shanxi, China, across gender and age groups.

H_4: Organizational resource perception has a significant positive effect on teachers' digital competence among university teachers in Shanxi, China.

H_5: Teacher agency mediates the relationship between organizational resource perception and teachers' digital competence among university teachers in Shanxi, China.

3.3. Research Participants and Sample

The participants of this study were teachers from five universities of different types in Shanxi Province, covering a diverse range of gender and age groups. A pilot survey was conducted with 140 teachers, and the formal survey yielded 813 valid responses. For the purpose of analyzing age-related differences across variables, teachers were categorized into four groups: under 30, 31–40, 41–50, and 51 years or older [23].

A purposive sampling strategy was employed, taking into account factors such as university type, geographic location, and academic rank, to ensure the representativeness of the sample. The questionnaire was distributed and collected online, which improved efficiency and reduced costs.

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3.4. Questionnaire Survey

A questionnaire survey was employed as the primary method of data collection. The online questionnaire was distributed to teachers from five universities of different types in Shanxi Province to ensure both coverage and convenience. The design of the questionnaire was based on the core variables of this study: organizational resource perception, teacher agency, and teachers' digital competence. Existing validated instruments were adapted to the higher education context in China. Specifically, the organizational resource perception scale included three dimensions: technological equipment support, training support, and service support. Teacher agency was measured using the scale developed by Liu, et al. [21] which assesses teachers' autonomy and proactivity in learning, teaching, and professional development. Teachers' digital competence was measured using the internationally recognized DIGIGLO questionnaire, which was translated and localized to suit the Chinese higher education context.

To ensure the scientific rigor and applicability of the questionnaire, two rounds of expert review were conducted by six specialists in the fields of educational management and educational technology. The experts evaluated the relevance, structural validity, and contextual suitability of the items. Following the revisions, the pilot test involved 140 participants. The results demonstrated strong content validity, with I-CVI values greater than .830 and S-CVI/UA ≥ .800. The items were found to be clear and easy to understand. Based on the pilot feedback, minor adjustments were made by modifying or deleting items that were ambiguous or redundant, thereby finalizing the questionnaire for large-scale administration.

A total of 830 questionnaires were distributed, of which 813 valid responses were retained after excluding cases with unrealistically short completion times or inconsistent responses, yielding an effective response rate of 97.95%. The sample covered teachers of different genders and age groups, ensuring representativeness of the findings. The collected data were analyzed using SPSS and AMOS, including tests of group differences, regression analysis, and mediation effect analysis. The Bootstrap method was employed to further verify the robustness of the mediation effects.

3.5. Research Instruments

Three types of scales were employed in this study: the Organizational Resource Perception Scale, the Teacher Agency Scale, and the Teachers' Digital Competence Scale. The Organizational Resource Perception Scale was developed with reference to relevant studies both in China and abroad, and included three dimensions—technological equipment support, training support, and service support—designed to measure teachers' subjective perceptions of institutional resources. Teacher agency was measured using the 24-item scale developed by Liu, et al. [21] which encompasses four dimensions: learning self-efficacy, teaching self-efficacy, optimism, and constructive participation, thereby providing a comprehensive reflection of teachers' proactivity and autonomy. Teachers' digital competence was assessed using a scale adapted from international digital competence standards and localized to the educational technology environment of Chinese universities. This instrument covered seven dimensions: professional engagement, digital resources, teaching and learning, assessment, empowering learners, facilitating learners' digital competence, and digital environment.

All items were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), with higher scores indicating stronger perceptions or performance in the corresponding dimension. To ensure validity and reliability, experts in education and educational technology were invited to conduct content validity evaluations. After several rounds of revision, the final version of the questionnaire was produced. Statistical analyses indicated high internal consistency, with Cronbach's α coefficients exceeding .850 for all three scales, and content validity indices (CVI) above .900, demonstrating satisfactory content validity and suitability for the empirical analysis of this study.

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3.6. Pilot Study

Before the formal distribution of the questionnaire, a pilot study was conducted to examine the feasibility, validity, and reliability of the instrument. The pilot sample included teachers from different types of universities, yielding 140 valid responses. Analysis of the pilot data indicated that the items across the three scales performed well in terms of logical structure, clarity of expression, and relevance. The item-level content validity indices (I-CVI) were all greater than .83, and the scale-level content validity index (S-CVI/UA) reached or exceeded .80, suggesting strong measurement validity. Reliability analysis showed Cronbach's α values ranging from .85 to .93, reflecting high internal consistency and demonstrating that the instruments were appropriate for large-scale data collection.

Based on the pilot feedback, several items were revised to improve clarity, while redundant or weakly correlated items were deleted. These refinements helped the scales remain concise and easy to understand, without compromising their core content. The results of the pilot study provided important evidence for the finalization of the questionnaire and ensured the reliability and validity of the subsequent data collection and statistical analyses, thereby laying a solid foundation for the overall research methodology.

4. Results

4.1. Correlation Analysis

To examine the relationships among the variables, Pearson correlation coefficients were calculated for organizational resource perception, teacher agency, and teachers' digital competence. The results revealed significant positive correlations: organizational resource perception was positively associated with teacher agency ($r = .691$, $p < .001$) and teachers' digital competence ($r = .722$, $p < .001$). Furthermore, the correlation between teacher agency and teachers' digital competence was particularly strong ($r = .768$, $p < .001$). Overall, these findings indicate close interrelationships among the three variables, consistent with the hypothesized directions.

A further test of multicollinearity was conducted. The variance inflation factor (VIF) values of the independent variables ranged from 2.348 to 2.713, with tolerance values exceeding .30. These results suggest that multicollinearity was not a serious concern, and the variables could be included in subsequent regression and mediation analyses. The summary of correlation results is presented in Table 1.

Table 1.
Summary of Correlation Analysis.

	Organizational Resource Perception	Teacher Agency	Teachers' Digital Competence	Tolerance	VIF
Organizational Resource Perception	1			0.426	2.348
Teacher Agency	0.691***	1		0.369	2.713
Teachers' Digital Competence	0.722***	0.768***	1	-	-

Note: This table presents the results of the correlation analysis. ***$p < .001$. VIF values below 10 and tolerance values above .30 indicate that no severe multicollinearity exists. The dependent variable (teachers' digital competence) was not included in the collinearity diagnostics; therefore, it is not reported in the corresponding columns.

4.2. Regression and Mediation Analysis

To further examine the effect of organizational resource perception on teachers' digital competence, regression analysis was conducted while controlling for gender and age. The results indicate that organizational resource perception significantly and positively predicts teachers' digital competence ($\beta = .667$, $p < .001$). In other words, the higher teachers' perception of organizational resources, the higher their level of digital competence. The overall model demonstrated good explanatory power (Adj. $R^2 = .537$), and the regression model was significant ($F = 189.667$, $p < .001$). These findings suggest that institutional support, technological equipment, and training resources provided by universities are critical factors for enhancing teachers' digital competence. The results are summarized in Table 2.

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Table 2.
Regression Analysis of Organizational Resource Perception on Teachers' Digital Competence.

	Dependent Variable			
	Teachers' Digital Competence			
	B	***SE***	**β**	***t***
Control variables	-	-	-	-
Gender	0.083	0.065	.061	1.270
Age	0.011	0.035	0.016	0.325
Independent variable	-	-	-	-
Organizational Resource Perception	0.594	0.025	0.667	24.208***
R^2	0.540			
Adj. R^2	0.537			
F	189.667***			
df	5, 807			

Note: This table presents the regression analysis of organizational resource perception on teachers' digital competence. ***$p < .001$. Gender was coded as a dummy variable (male = 1, female = 0), and age was treated as a continuous variable.

Building on this, teacher agency was introduced as a mediating variable, and the PROCESS macro (Model 4) was applied to conduct a Bootstrap test with 5,000 resamples and a 95% confidence interval. The results revealed that the direct effect of organizational resource perception on teachers' digital competence was significant (β = .327, 95% CI [.277, .376]). The indirect effect through teacher agency was also significant (β = .316, 95% CI [.276, .361]), and the total effect was β = .643, 95% CI [.600, .685]. These findings indicate that teacher agency plays a partial mediating role in the relationship between organizational resource perception and teachers' digital competence. In other words, organizational resources not only directly enhance teachers' digital competence, but also exert an indirect effect by strengthening teacher agency (see Table 3).

Table 3.
Summary of Bootstrap Mediation Analysis of Teacher Agency.

Path	**Estimate (β)**	***SE***	**95% LLCI**	**95% ULCI**
Direct Effect	0.327	0.025	0.277	0.376
Indirect Effect	0.316	0.021	0.276	0.361
Total Effect	0.643	0.022	0.600	0.685

Note: This table presents the Bootstrap mediation analysis of teacher agency. LLCI = lower limit of the confidence interval; ULCI = upper limit of the confidence interval.

In summary, the regression analysis results demonstrate that organizational resource perception not only directly enhances teachers' digital competence, but also indirectly influences it by strengthening teacher agency, thereby confirming Hypotheses H4 and H5.

5. Discussion

Through correlation, regression, and mediation analyses, this study confirmed the significant positive effect of organizational resource perception on teachers' digital competence and revealed the partial mediating role of teacher agency.

First, the findings show that there are differences across gender and age groups among university teachers, indicating that demographic variables still play a role in the enhancement of teachers' digital competence [24-26]. This result is consistent with previous research on the heterogeneity of teachers' digital competence and highlights the need for educational administrators to consider group differences when designing training programs [27, 28].

Second, organizational resource perception was found to significantly and directly predict teachers' digital competence. Previous studies have indicated that the availability of institutional and technological resources enhances teachers' willingness to engage in digital teaching, thereby facilitating

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the development of their digital competence [28, 29]. When teachers perceive institutional support in terms of policy development, technological infrastructure, and training opportunities, they are more likely to cultivate positive intentions and abilities for digital application in their teaching practices [25].

Furthermore, the mediation analysis demonstrated that teacher agency partially mediated the relationship between organizational resource perception and teachers' digital competence. This finding suggests that institutional resources not only directly improve digital competence, but also indirectly promote its development by enhancing teachers' self-efficacy, constructive participation, and positive attitudes [21, 30]. Previous research has also emphasized the central role of teacher agency in educational practice, arguing that it significantly shapes the extent to which teachers integrate new technologies and resources [31]. The present study therefore reinforces the "resource–psychological mechanism–competence development" pathway and offers a new perspective on the internal mechanisms underlying the development of teachers' digital competence [21, 32].

In summary, the findings of this study not only validate existing theories but also uncover the contextual uniqueness of the interaction between organizational support and psychological factors in Chinese higher education. This provides an empirical foundation for future research on the mechanisms underlying the development of teachers' digital competence.

6. Conclusion

Drawing on survey data from 813 university teachers in Shanxi Province, this study verified the significant positive effect of organizational resource perception on teachers' digital competence and revealed the partial mediating role of teacher agency. The findings suggest that external resources not only directly enhance teachers' digital competence, but also indirectly strengthen it by activating individual agency.

The study provides several practical implications. Universities should optimize resource allocation by ensuring institutional support, technological infrastructure, and training opportunities. At the same time, greater attention should be paid to fostering teachers' learning self-efficacy and constructive participation so that teacher agency can play a stronger role in transforming resources into professional competence. In addition, institutional administrators need to recognize gender- and age-related differences and design differentiated support and training strategies accordingly.

Although this study has certain limitations, the overall results offer important empirical evidence for understanding the mechanisms underlying the development of teachers' digital competence in higher education.

7. Implications

Theoretically, it integrates organizational resource perception, teacher agency, and teachers' digital competence into a unified framework, verifying the mediating role of teacher agency. In doing so, it enriches the research on the mechanisms underlying digital competence development and provides localized empirical evidence from the context of higher education in Shanxi Province, China. These findings offer a new perspective for cross-cultural comparisons and the advancement of educational technology theories.

Practically, the results suggest that universities should optimize the allocation of institutional and technological resources to strengthen teachers' positive perceptions of resources. At the same time, it is important to cultivate teacher agency by encouraging proactive learning and innovative applications. Moreover, differentiated training programs should be developed based on gender and age differences, thereby supporting teachers' professional development more effectively and facilitating the digital transformation of higher education institutions.

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8. Limitations and Recommendations

Although this study reveals the important relationships among organizational resource perception, teacher agency, and teachers' digital competence, several limitations should be acknowledged. First, the sample was limited to universities in Shanxi Province, which constrains the regional representativeness of the findings. Second, the use of a cross-sectional survey design makes it difficult to capture the dynamic causal relationships among the variables. Third, the data relied primarily on self-reported measures, which may be subject to bias. Fourth, potential influencing factors such as academic rank and disciplinary background were not fully considered.

Future research could address these limitations in several ways. Expanding the sample to include a broader range of regions would improve generalizability. Employing longitudinal or mixed-method designs could better capture the dynamic processes at play. Incorporating multi-source data (e.g., classroom observations, student evaluations) would help reduce bias and enhance validity and reliability. Additionally, integrating variables such as teacher identity, organizational climate, or policy environment could further deepen the understanding of the mechanisms underlying the development of teachers' digital competence.

Institutional Review Board Statement:

This study was approved by the Ethical Committee of Dhurakij Pundit University on 10 June 2025 (Ref. No. DPU_BSH 1006/2567).

Transparency:

The authors confirm that the manuscript is an honest, accurate and transparent account of the study that no vital features of the study have been omitted and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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