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Mechanism and Optimization Path of Primary and Secondary School Teachers' Selection of Digital Resources Based on ISM

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Abstract: The selection of digital educational resources by primary and secondary school teachers is a key link in improving teaching quality and advancing educational informatization. Based on technology adoption theories, this study proposes a framework of influencing factors: Technology–Organization–Environment–Data–Individual Perceptual Judgment. Core constructs of relevant theories are synthesized to initially construct an influencing factor system. Two rounds of expert consultation are conducted to screen and validate 22 operational influencing factors. An Interpretive Structural Model (ISM) is employed to develop a hierarchical structure map that presents the hierarchical relationships and directed associations among factors. Based on the action paths identified from the hierarchical model, complex relationships are transformed into actionable strategies to optimize teachers' selection behavior of digital educational resources.

1. Introduction

China's Education Modernization 2035 lists "accelerating educational reform in the information age" as a core goal, explicitly advocating the construction of integrated intelligent teaching platforms to promote high-quality educational development[1]. Traditional teaching is constrained by the singularity of physical resources, struggling to balance vivid knowledge delivery with personalized learning needs. Digital educational resources, with their multimedia, interactive, and contextualized features, transform abstract subject knowledge into concrete dynamic demonstrations, significantly enhancing student engagement and deepening knowledge comprehension. Zhu et al. (2021) argue that inclusive application of digital educational resources is critical for advancing equal access to basic public education services[2].

In the era of Educational Informatization 2.0, educational resources are characterized by explosive quantity, diverse forms, and easy accessibility. However, a structural mismatch persists between resource supply and actual teaching demands. OECD reports note that despite sustained increases in educational technology investment worldwide, a significant gap remains between resource input and improved learning outcomes[3]. This highlights the complexity of resource implementation: physical availability does not guarantee effective integration into teaching practice or full realization of educational value[4]. Teachers are the ultimate interpreters and contextual adapters of resources; their selection behavior directly determines whether resources enter classrooms and how effectively they perform[5]. Analyzing resource selection from a teacher–resource perspective—identifying influencing factors, exploring hierarchical structures, and proposing recommendations—can promote the effective use of digital resources and advance China's digital education strategy.

Against the backdrop of educational digitization, digital educational resources have grown exponentially and become critical for classroom innovation and quality improvement in primary and secondary schools. Yet a notable gap exists between abundant resources and effective classroom application, leaving many high-quality digital resources underutilized. As core agents in resource selection and application, teachers' behavior is shaped by intertwined factors including resource characteristics, school environment, policy orientation, and individual cognition. Clarifying internal relationships and action paths among these factors is key to addressing resource underutilization and unlocking educational value. Existing studies mainly focus on single-factor identification or correlation verification, answering surface-level questions such as "which factors matter" or "whether effects are significant." They lack systematic analysis of hierarchical structures and transmission mechanisms, making it difficult to pinpoint core leverage points for optimizing selection behavior. ISM can organize scattered factors into a clear hierarchy and visualize inter-factor relationships.

2. Hierarchical Structure Analysis of Influencing Factors Based on ISM

This study initially constructs an influencing factor system covering five dimensions—technology, organization, environment, data, and individual perceptual judgment—via literature analysis. Two rounds of Delphi expert consultation are then conducted for screening and revision. The validated factor system provides a scientific, reliable foundation for ISM construction.

2.1. Initial Construction of the Influencing Factor System

With advances in digital technology, data elements play an increasingly central role in organizational innovation and transformation, limiting the explanatory power of the classic TOE framework. Cao et al. first proposed the TOED framework to address this gap[6]. To center the teacher as the core decision-maker, this study introduces an Individual Perceptual Judgment (STJ) dimension, forming a TOED-STJ framework (Figure 1). Grounded in social cognitive theory and the Unified Theory of Acceptance and UTAUT, this revised framework systematically maps factors from objective external conditions to teachers' subjective perceptions.

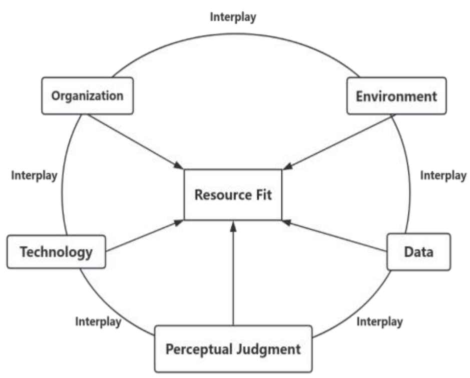

Figure 1: The "TOED-STJ" Factor Identification Framework.

Referring to the TOED-STJ framework, core concepts from classic technology adoption theories (Innovation Diffusion Theory/IDT, social cognitive theory, UTAUT, Information Systems Success Model) are mapped to five dimensions: technology, organization, environment, data, and individual perception. A structured, actionable list of factors is derived (Table 1).

Table 1: Influencing Factor System and Descriptions.

Dimension	Key Factor	Theoretical Source
T	T1 Relative Advantage	Diffusion of Innovations Theory
	T2 Compatibility	Diffusion of Innovations Theory
	T3 Trialability	Diffusion of Innovations Theory
	T4 Observability	Diffusion of Innovations Theory
	T5 System Quality	Information Systems Success Model
	T6 Information Quality	Information Systems Success Model
	T7 Service Quality	Information Systems Success Model
	T8 Content Quality	UTAUT & Information Systems Success Model
O	O1 Management Support	TOE Framework
	O2 School Digital Construction	TOE Framework
	O3 Professional Development & Training	TOE / Social Cognitive Theory
	O4 Peer Influence	UTAUT (Social Influence)
	O5 School Culture & Innovation Climate	TOE / Social Cognitive Theory
E	E1 Government Policy & Funding	TOE Framework
	E2 External Pressure & Competition	TOE Framework
	E3 Social Norms & Expectations	UTAUT (Social Influence)
	E4 Policy Incentives & Institutional Safeguards	TOE Framework

Table 1(Continued): Influencing Factor System and Descriptions.

Dimension	Key Factor	Theoretical Source
D	D1 Data Quality	Information Technology-Data Quality Evaluation Indicators[7]
	D2 Data Security	Information Technology-Big Data Reference Architecture-Part 4:Security and Privacy Protection[8]
	D3 Data Sharing	TOED Theoretical Framework
S	S1 Self-efficacy	Social Cognitive Theory
	S2 Outcome Expectation	Social Cognitive Theory
	S3 Attitude and Belief	Social Cognitive Theory
	S4 Perceived Usefulness & Ease of Use	UTAUT / UTAUT2
	S5 Habit & Hedonic Motivation	UTAUT2
	S6 Task-Technology Fit / Task Matching	Diffusion of Innovations, TOE, TPACK

2.2. Validation of the Influencing Factor System

2.2.1. First Round of Expert Consultation

Twelve experts participated, including scholars in digital education resources, subject teaching researchers, frontline primary/secondary teachers, and teaching researchers. Experts evaluated factor accuracy, clarity, and rationality via quantitative scoring. Descriptive statistics and reliability analysis were conducted (Table 2).

All factors scored above 3.5, indicating high content validity. Coefficients of variation for D1 (Data Quality), D2 (Data Security), S6 (Task-Technology Fit), and T4 (Service Quality) were below 0.15, reflecting strong expert consensus. Higher coefficients for T1 (Content Quality) and O4 (Peer Influence) (exceeding 0.3) indicated divergent views, likely due to ambiguous definitions or disciplinary differences. These factors were revised based on expert feedback.

Table 2: Descriptive Statistics of First-round Expert Ratings.

Indicator	Minimum	Maximum	Mean	Std. Deviation	Coefficient of Variation
T	3.00	5.00	4.583	0.669	0.146
O	2.00	5.00	4.167	1.030	0.247
E	2.00	5.00	4.000	1.128	0.282
D	2.00	5.00	4.167	0.937	0.225
S	2.00	5.00	4.333	0.985	0.227
T1	1.00	5.00	4.167	1.267	0.304
T2	2.00	5.00	4.417	0.900	0.204
T3	2.00	5.00	4.250	1.138	0.268
T4	3.00	5.00	4.583	0.669	0.146
T5	2.00	5.00	4.500	0.905	0.201
T6	3.00	5.00	4.000	0.853	0.213
T7	2.00	5.00	4.000	0.853	0.213
T8	3.00	5.00	4.500	0.798	0.177
O1	3.00	5.00	4.417	0.793	0.180
O2	3.00	5.00	4.333	0.779	0.180
O3	3.00	5.00	4.333	0.779	0.180
O4	1.00	5.00	4.000	1.477	0.369
O5	3.00	5.00	4.333	0.779	0.180
E1	2.00	5.00	4.083	1.084	0.265
E2	2.00	5.00	3.833	1.115	0.291
E3	2.00	5.00	3.917	1.084	0.277
E4	2.00	5.00	4.167	0.937	0.225
D1	4.00	5.00	4.583	0.515	0.112
D2	4.00	5.00	4.500	0.522	0.116
D3	2.00	5.00	4.167	1.030	0.247
S1	2.00	5.00	4.417	0.996	0.226
S2	2.00	5.00	4.417	0.996	0.226
S3	2.00	5.00	4.167	1.193	0.286
S4	2.00	5.00	4.333	0.888	0.205
S5	3.00	5.00	4.333	0.888	0.205
S6	3.00	5.00	4.750	0.622	0.131
Valid N (listwise):12					

2.2.2. Second Round of Expert Consultation

The sample size was expanded to 40 experts. Five dimensions scored between 4.025–4.225, indicating high agreement (Table 3). Technology and organization dimensions ranked highest, confirming resource characteristics and school support as core prerequisites. Environment and perception dimensions were also highly valued, and the data dimension was significantly above the midpoint (3), highlighting growing recognition of data's importance. Coefficients of variation for all dimensions were below 0.25, reflecting low divergence.

Table 3: Descriptive Statistics of Dimension Consultation Scores.

Indicator	Minimum	Maximum	Mean	Std. Deviation	Coefficient of Variation
T	4.225	0.768	2.000	5.000	0.182
O	4.225	0.733	2.000	5.000	0.174
E	4.175	0.813	2.000	5.000	0.195
D	4.025	0.891	2.000	5.000	0.221
S	4.175	0.813	2.000	5.000	0.195
Valid N (listwise):40					

Twenty-two core factors were retained. All coefficients of variation were below 0.23 (far below the 0.3 divergence threshold), indicating strong consensus (Table 4). T5 (Service Quality) had the lowest variation (0.152). S1 (Self-Efficacy), S4 (Perceived Usefulness), and S6 (Task-Technology Fit) were the most consistent, reflecting agreement on core perceptual factors. E2 (External Pressure) scored lowest (3.950) but remained low divergence, indicating weaker but consistent importance.

Table 4: Second-round Expert Rating Statistics.

Indicator	Minimum	Maximum	Mean	Std. Deviation	Coefficient of Variation
T1	4.250	0.776	2.000	5.000	0.183
T2	4.150	0.770	2.000	5.000	0.185
T3	4.225	0.768	2.000	5.000	0.182
T4	4.275	0.784	2.000	5.000	0.183
T5	4.350	0.662	3.000	5.000	0.152
T6	4.400	0.744	3.000	5.000	0.169
T7	4.300	0.853	1.000	5.000	0.198
T8	4.325	0.764	2.000	5.000	0.177
O1	4.300	0.791	2.000	5.000	0.184
O2	4.150	0.864	2.000	5.000	0.208
O3	4.150	0.834	1.000	5.000	0.201
O4	3.950	0.783	2.000	5.000	0.198
O5	3.975	0.800	2.000	5.000	0.201
E1	4.350	0.770	2.000	5.000	0.177
E2	4.250	0.840	2.000	5.000	0.198
E3	4.225	0.832	1.000	5.000	0.197
E4	4.325	0.730	2.000	5.000	0.169
D1	4.325	0.859	1.000	5.000	0.199
D2	4.300	0.758	2.000	5.000	0.176
D3	4.350	0.736	2.000	5.000	0.169
S1	4.325	0.859	1.000	5.000	0.199
S2	4.350	0.736	2.000	5.000	0.169
S3	4.250	0.776	2.000	5.000	0.183
S4	4.150	0.770	2.000	5.000	0.185
S5	4.225	0.768	2.000	5.000	0.182
S6	4.275	0.784	2.000	5.000	0.183
Valid N (listwise):40					

Kendall's W = 0.674 ($p < 0.001$), indicating good inter-rater reliability ($W > 0.6$ = substantial agreement[9], Table 5).

Table 5: Expert Rating Consistency Analysis.

N	Kendall's W	Chi-square	df	P
27	0.674	709.766	39	<0.001

2.2.3. Finalization of the Influencing Factor System

After two rounds of consultation, a final system of 5 dimensions and 22 core factors was established (Table 6).

Table 6: Final List of Influencing Factors.

Dimension	Influencing Factor Categories
T	T1 Content Quality, T2 Trialability, T3 System Quality, T4 Service Quality, T5 Relative Advantage, T6 Observability
O	O1 Management Support, O2 School Digital Construction, O3 Professional Development & Training, O4 Peer Influence
E	E1 Policy Incentives & Institutional Safeguards, E2 External Reference & Benchmarking Effect, E3 Social Norms & Expectations
D	D1 Data Quality, D2 Data Security, D3 Data Sharing
S	S1 Self-efficacy, S2 Outcome Expectation, S3 Perceived Usefulness, S4 Perceived Ease of Use, S5 Habit & Teaching Interest, S6 Task Matching

2.3. Construction of the Hierarchical Model

2.3.1. Adjacency Matrix Construction

A 22×22 adjacency matrix was built via expert pairwise comparison (0 = no direct influence, 1 = direct influence, Figure 2).

	T1	T2	T3	T4	T5	T6	O1	O2	O3	O4	E1	E2	E3	D1	D2	D3	S1	S2	S3	S4	S5	S6
T1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
T6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
O2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
O3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1	0	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
E2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
E3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
D2	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
D3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
S3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
S4	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0
S5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
S6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

Figure 2: Adjacency Matrix.

A reachability matrix (direct + indirect effects) was computed using MATLAB (Figure 3).

	T1	T2	T3	T4	T5	T6	O1	O2	O3	O4	E1	E2	E3	D1	D2	D3	S1	S2	S3	S4	S5	S6
T1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T5	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	1	1	1	1	0	1
T6	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
O1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
O2	0	1	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
O3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
O4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
E1	0	1	1	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
E2	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	1	1	1	1	0	1
E3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
D1	1	0	0	1	1	0	0	0	1	1	0	1	0	1	0	1	1	1	1	1	0	1
D2	0	1	1	1	0	0	1	1	1	0	1	0	0	0	1	1	0	0	0	0	0	0
D3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
S1	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	1	1	1	1	0	1
S2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1
S3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
S4	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	1	1	1	1	0	1
S5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1
S6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1

Figure 3: Reachability Matrix.

2.3.2. Hierarchy Partitioning and Structural Mapping

Using SPSSAU-ISM, reachable sets, antecedent sets, and intersection sets were calculated. Nodes satisfying reachable set = intersection set were assigned to Level 1 (top). Iterative partitioning yielded four hierarchical levels (Table 7).

Table 7: Hierarchical Partitioning Results of Influencing Factors.

Level	Elements
Level 4 (Top)	Factor 2, Factor 4, Factor 9, Factor 19, Factor 22
Level 3	Factor 3, Factor 7, Factor 10, Factor 18
Level 2	Factor 1, Factor 5, Factor 8, Factor 11, Factor 12, Factor 16, Factor 17, Factor 20
Level 1 (Bottom)	Factor 6, Factor 13, Factor 14, Factor 15, Factor 21
Based on: Driver-Priority Downward (i.e., top-down partitioning prioritizing root causes)	

A four-level ISM hierarchy was drawn (Figure 4):

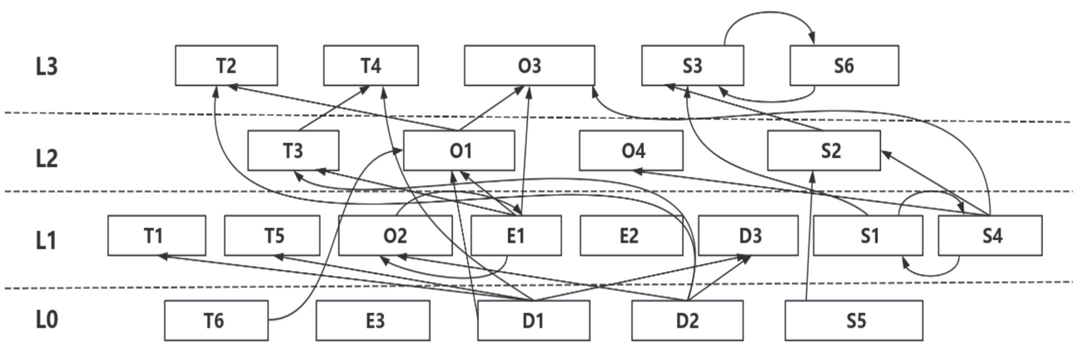

Figure 4: Hierarchical Structure Model.

Bottom (Root): T6 (Observability), E3 (Social Norms), D1 (Data Quality), D2 (Data Security), S5 (Habit & Interest).

Core Drivers: T1 (Content Quality), T5 (Relative Advantage), O2 (Digital Infrastructure), E1 (Policy), E2 (External Reference), D3 (Data Sharing), S1 (Self-Efficacy), S4 (Ease of Use).

Mediators: T3 (System Quality), O1 (Management Support), O4 (Peer Influence), S2 (Outcome Expectation).

Top Outcomes: T2 (Trialability), T4 (Service Quality), O3 (Training), S3 (Usefulness), S6 (Fit).

3. Multi-Level Action Paths and Promotion Strategies

ISM reveals five key paths:

Data-Driven: D1→O1→O3.

Security-Guaranteed: D2→T3→T4.

Value-Perception: T6→O1→O3.

Individual Cognition: S4→S2→S3.

Policy-Guided: E1→O1→O3.

3.1. Data Security and System Quality Assurance

Data Quality as a Dashboard: Provide school management with visualized usage data to identify needed resources and training gaps; minimize data collection interference.

Explicit Security Cues: Display encryption, access rights, and privacy guarantees during resource operations to reduce teacher concerns.

Fix Technical Pain Points: Address lag and crashes during peak hours for reliable, accountable service.

Diagnostic Training: Replace generic tutorials with problem-solving workshops targeting actual bottlenecks identified via data.

3.2. Policy Incentives and Organizational Support Transmission

Decentralized Policy Implementation: Integrate resource selection into teaching research group assessment; offer micro-innovation awards for teacher-developed resources, embedded in school repositories with public recognition.

Observable Peer Evidence: Require 1–2 comparative case studies per teaching research group (before/after resource use: classroom footage, student engagement, work data) for internal demonstration.

Managerial "Walkthroughs": School leaders join collective lesson planning and observations to resolve technical issues in person, signaling tangible support.

3.3. Activation of Individual Cognitive Chains

Zero-Learning Onboarding: Provide one-click lesson templates with embedded 30-second demo videos; establish rapid-response peer support teams.

Small Wins for Expectation: Start with single lesson segments (e.g., introductions, quizzes); document improvements in attention and error rates; share micro-evidence regularly.

Usefulness as Workload Reduction: Auto-align resources to local curricula; suggest smart revisions for reuse; co-develop high-fit resource packs to save lesson-planning and grading time.

4. Conclusions

This study constructs a four-level hierarchical model of teachers' digital resource selection factors, advancing beyond parallel-factor models to capture structural integrity and traceable paths. Five actionable strategies are proposed: foundation assurance→organizational leverage→cognitive activation, providing clear, operational theory for intervention and optimization. The hierarchy enables interpretable AI recommendations and teacher profiling.

Limitations include regional sampling. Future work will expand samples across regions, school types, and urban/rural contexts for generalizability; combine large-scale surveys and SEM for quantitative validation; and train machine learning models on behavioral logs to improve predictive accuracy of key drivers and outcomes.

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