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ARTICLE

Educational Competitive Intelligence Capability: An Organizational Framework for Environmental Scanning, Intelligence Utilization, and Academic Decision Support

Capacidade de Inteligência Competitiva Educacional: Uma Estrutura Organizacional para Monitoramento Ambiental, Utilização da Inteligência e Apoio à Decisão Acadêmica

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ABSTRACT | **Purpose:** This study develops and tests educational competitive intelligence as an organizational capability that connects environmental scanning, intelligence utilization, governance and dissemination, and academic decision support in B-S-J-Z schools. **Methodology/Approach:** The OECD PISA 2018 school questionnaire was linked to the student file for 361 schools and 12,058 students in Beijing, Shanghai, Jiangsu, and Zhejiang. Twenty-three principal-reported practices formed transparent, theory-led organizational bundles. School-weighted least-squares models used heteroskedasticity-robust standard errors, 1,000 school bootstrap replications, sensitivity tests, and capability-profile analysis. No expert panel, Delphi process, interviews, or previously validated CI instrument was used. **Originality/Relevance:** The framework moves competitive intelligence beyond a pedagogical metaphor by locating planning, collection, analysis, dissemination, utilization, feedback, ethics, and decision support within the educational organization. **Key Findings:** Environmental scanning was positively associated with intelligence utilization (B = .481) and academic decision support (B = .358). The independent utilization-to-decision-support path was positive but uncertain in the baseline model (B = .167), while an intensity-coded sensitivity model produced a significant estimate. Two capability profiles revealed a persistent gap between widespread monitoring and the selective use of information for retention, grouping, parental communication, and other academic decisions. **Theoretical/Methodological Contributions:** The study specifies an auditable organizational CI cycle, distinguishes formative practice bundles from validated latent scales, and shows that information availability should not be equated with decision capability. The results support institutional monitoring and governance while remaining associational and geographically bounded.

Keywords | Educational competitive intelligence. Organizational capability. Environmental scanning. Intelligence utilization. Academic decision support. Intelligence governance. PISA 2018

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RESUMO | Objetivo: Desenvolver e testar a inteligência competitiva educacional como uma capacidade organizacional que integra monitoramento ambiental, utilização da inteligência, governança e disseminação, e apoio à decisão acadêmica em escolas de B-S-J-Z. **Metodologia/Abordagem:** O questionário escolar do PISA 2018 foi vinculado ao arquivo dos estudantes, abrangendo 361 escolas e 12.058 estudantes de Pequim, Xangai, Jiangsu e Zhejiang. Vinte e três práticas informadas pelos diretores compuseram conjuntos organizacionais orientados pela teoria. Foram aplicados modelos de mínimos quadrados ponderados, erros-padrão robustos, 1.000 reamostragens por escola, análises de sensibilidade e identificação de perfis de capacidade. Não foram utilizados painel de especialistas, processo Delphi, entrevistas ou instrumento de IC previamente validado. **Originalidade/Relevância:** A proposta situa o ciclo de inteligência competitiva no nível organizacional da instituição educacional, incluindo planejamento, coleta, análise, disseminação, utilização, retorno, ética e apoio à decisão. **Principais Resultados:** O monitoramento ambiental apresentou associação positiva com a utilização da inteligência (B = 0,481) e com o apoio à decisão acadêmica (B = 0,358). O efeito incremental da utilização sobre o apoio à decisão foi positivo, porém impreciso no modelo principal. Dois perfis organizacionais mostraram que práticas de monitoramento são mais difundidas do que alguns usos decisórios específicos. **Contribuições Teóricas/Metodológicas:** O estudo diferencia disponibilidade de informação e capacidade decisória, trata os conjuntos de práticas como formativos e oferece uma operacionalização organizacional auditável. Os indicadores não são apresentados como índices oficiais do PISA, como uma escala validada de inteligência competitiva ou como evidência causal.

Palavras-chave | Inteligência competitiva educacional. Capacidade organizacional. Monitoramento Ambiental. Utilização da inteligência. Apoio à decisão acadêmica. Governança da inteligência. PISA 2018

1 INTRODUCTION

An educational institution is an information-intensive organisation. There's a constant flow of signals coming from student assessment data, attendance, curriculum reviews, teacher observations, parent communications, and traces on digital platforms, to name a few. The problem is not the lack of information itself, but unevenly distributing that information, determining its value, combining it with the contextual information, disseminating it to the right people, and making it into a defensible academic decision. Without integration, a school may end up with several reports and teachers and managers may be operating without the latest information or on outdated information. This results in poor information flow between classrooms, leadership teams, families and governing bodies and the lack of opportunities for early intervention.

To solve this problem, there is an organized approach to the problem – competitive intelligence (CI). The historical evolution transformed the field from competitor monitoring to a more comprehensive capability for intelligence definition, collection, analysis, sharing of actionable information, decision support, and learning from results. Herring's key-intelligence-topic approach involved placing the collection of data before the requirement to make decisions; Prescott and Miller highlighted the organizational processes in which intelligence is used; Fleisher and Bensoussan structured analytic techniques; and Calof and Wright linked practitioner and academic perspectives. Subsequent research has made more explicit the modularity and context-dependency of CI, as it is not a technology or a department, but rather a set of practices (Calof & Wright, 2008; Fleisher & Bensoussan, 2015; Herring, 1999; Madureira et al., 2021; Prescott & Miller, 2001).

This organizational knowledge is particularly applicable to the field of education. Educational intelligence is not about overcoming competition; educational schools are not businesses; the students

are not competitors. However, educational institutions must make decisions regarding priorities for curriculum, instructional support, grouping, retention and promotion, staff development, resources, and family communication, as well as decisions on school improvement. All three options rely on an intelligence cycle: the need to make a decision must be stated; evidence must be gathered; its quality and meaning evaluated; it must be shared in an appropriate and responsible way; managers and teachers must assimilate the findings and adapt practice; and they must monitor outcomes and refine practice based on the results. It's about the coordination of these activities, not the possession of a dashboard.

The gap in science is more particular than "There is a need for more data in education". There is ample evidence supporting the effectiveness of formative assessment and adaptive instruction (Burić & Kim, 2020), teacher feedback (Ma et al., 2021, 2022; Wisniewski et al., 2020), digital literacy, and motivational support. Research on CI, however, has focused on topics such as environmental scanning, analytical processes, dissemination, maturity, and strategic decision-making (Cavallo et al., 2021; Dishman & Calof, 2008; Madureira et al., 2023; Robinson et al., 2021). There is not much overlap in the organizational level in these literatures. Assessment and feedback are often considered as classroom activities in educational studies and rarely explored in relation to the institutionalization of capacity for monitoring and academic decisions within schools in CI studies. Without such a bridge, there is a tendency to metaphorically use the term intelligence in reference to any information related classroom activity, without providing evidence of organizational planning, governance, dissemination or decision support.

The empirical gap has no less significance. Practices of evaluation, recording, assessment use, curricular standards, teacher collaboration, and communication are documented at the school level in existing education surveys, but not often as a clear CI cycle. Beijing, Shanghai, Jiangsu and Zhejiang provide a bounded opportunity for a study of such routines in the B-S-J-Z economy: the school questionnaire of the OECD PISA 2018. Data are not a validated CI instrument, and are not intended to support causal or national claims. But they allow for an auditable process of organizational operationalisation that relies on principals' reports, common identifiers, linked school weights and student context. The method is more effective than relying on students' motivational perceptions of the organization's capacity.

Study is theoretically, managerially and policy justified. It defines theoretically the educational organization as the unit of coordination for planning, collection, analysis, dissemination, utilization, and feedback. Managerially, it helps leaders recognize if the information cycle is being broken or not and if there is information-rich practice or intelligence capable practice. It connects accountability and digitalisation to governance, ethics, institutional learning instead of viewing data collection as a goal. A sustainable educational advantage is defined in this context as the capacity to learn from evidence, to modify education, and to have confidence rather than competition between students.

The goal is to find a framework for the educational competitive intelligence capability in the organization and test it empirically by conducting a study. The analysis is guided by three research questions. RQ1 focuses on how documented School practices can be organized to form an educational CI capability, keeping the classical Intelligence cycle intact. RQ2 is how environmental scanning and intelligence utilization are related, along with governance and dissemination, and academic decision

support after the observable condition of schools is taken into consideration. RQ3 seeks to identify the profiles of capabilities that can be found in the participating schools and practices that explain the primary differences between monitoring and decision use.

The study has four contributions. First, it operates at the organization level, not at the individual level: it distinguishes the practice bundles at the empirical level from the OECD scales. Second, it offers an operationalization of the school level that is transparent and uses classical CI stages and governance. Third, it employs school-weighted modelling, powerful uncertainty estimation, 1,000 school bootstrap replications, sensitivity analyses, and profile analysis to assess the sensitivity of conclusions to coding and specification. Fourth, it turns the statistical pattern into an institutional diagnostic: what schools measure, what they use assessment information for, what they share and disseminate about, and what decisions are less well supported.

2 THEORETICAL FRAMEWORK

2.1 Competitive intelligence as an organizational capability

Competitive intelligence is more of a process or practice than a report, software product, or specific analyst job. Herring (1999) contended that the initial stages of intelligence work start with topics of key intelligence identified from decision needs. This planning logic has consequences, without a question, there is volume, not relevance. Prescott and Miller (2001) later presented evidence for the embedding of CI routines within organizations, through processes of sponsorship, communication, analytical discipline, and learning, and Fleisher and Bensoussan (2015) demonstrated that analytic methods do not add value unless they are matched with the decision problem. Calof and Wright's (2008) practitioner-academic synthesis confirmed that the field is inherently interdisciplinary and focused on the support of decision making in a lawful, ethical and forward-looking manner.

The modern definitions keep this cycle but lessen the commercial competition. Pellissier and Nenzhelele (2013) stressed the importance of a systematic and ethical process, while Madureira et al. (2021) have suggested a modular definition, covering planning, collection, analysis, communication, use and organizational learning. The modularity allows transfer to education as long as the object and purpose are stated explicitly. The ability of an institution to coordinate its efforts to identify academic intelligence needs and to gather and analyse reliable internal and external signals, share relevant insight in a structured way and according to an agreed governance, apply it in academic decisions and to act on it based on feedback is therefore seen here as an educational CI capability.

The importance of capability language is to highlight attention to routines, roles and coordination. A school might have assessment systems, and not have the human and organizational structure to interpret the results. It can be passive about disseminating information without making sure that it is understood. Can see a learning gap and may not be able to do something about it because of a lack of authority, time or resources. Research on dynamic capability also separates it from information possession and sensing, and focuses on seizing and reconfiguring around information (Wu et al., 2023). The sustainable part in education is the capacity to repeatedly convert evidence into adaptation based on fairness, transparency, and trust.

2.2 The intelligence cycle in educational institutions

The proposed framework is based on the classical intelligence cycle. Planning sets the context for the academic decision and the information needed. Collection gathers appropriate signals from internal evaluation, external evaluation, administrative records, achievement, students, families, teachers and policy environments. Analysis evaluates quality, identifies patterns, compares performance over time or with standards and makes implications based on evidence. Dissemination provides suitable intelligence to leaders, teachers, students, parents and governing bodies in a suitable format. Utilization: incorporates the insight into curriculum, instruction, grouping, retention, staff support and resource decisions. Feedback assesses consequences and then feeds into the next planning cycle.

The sensing part of this cycle is known as environmental scanning. The authors Robinson et al. (2021) demonstrate the conceptual disintegration of noticing, interpretation, and action in scanning research. The educational parallel is the assumption that the evaluation and data recording process, the student feedback, and tracking of student achievement are separate administrative functions. These practices make up a portfolio of sources in an organisational CI system that helps to minimize uncertainty regarding academic conditions. Internal evaluation identifies school-specific problems; external evaluation offers an outside perspective; systematic records offer continuity; student feedback offers experiential evidence and, finally, longitudinal tracking offers an outside perspective of patterns that will not be identified by single evaluations.

The external environment is also embraced by scanning. The meaning of internal performance data may change over time because of changes in demographics, curriculum standards, examination policies, technological advancement, labour-market expectations, public-health conditions, community needs, and other factors. This larger domain is only partially assessed by the school questionnaire of PISA and is thus described as a school-practice bundle. The broader organizational context is shown in figure 1, with the core layers of planning, governance, ethics, technology and organizational learning shown as enabling layers.

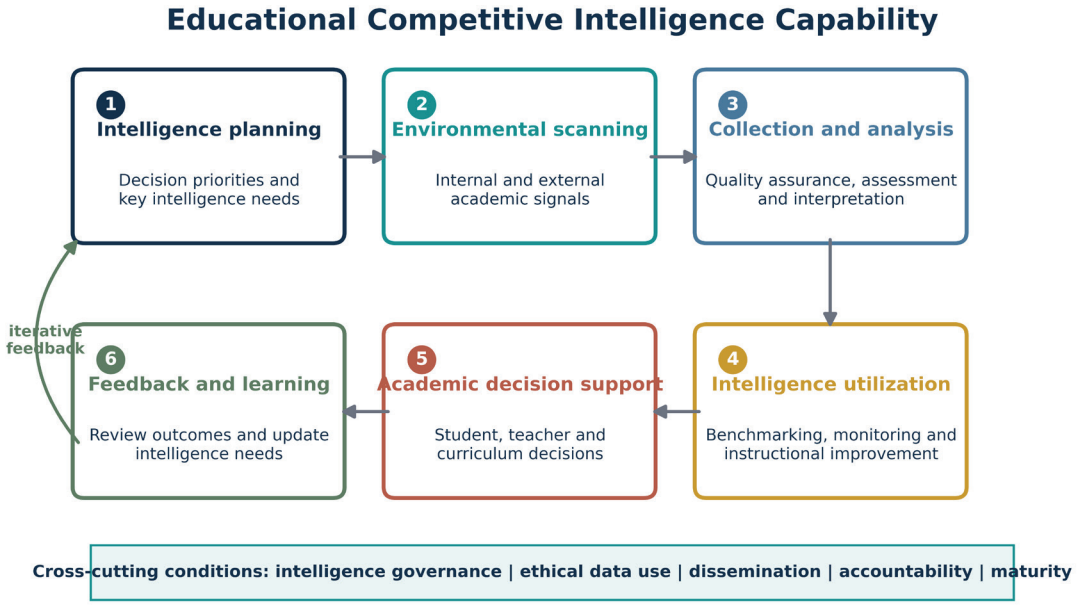


Figure 1. Organizational framework for educational competitive intelligence capability.

2.3 Intelligence utilization and academic decision support

The point at which information is analysed and it affects institutional judgement or action is intelligence utilization. Dishman and Calof (2008) view CI as a multiphasic process on the way to strategy and not the end point, while Cavallo et al. (2021) link intelligence activities to the formulation of strategy by depicting how information's value is derived from interpretation and integration. In schools, utilization means comparing with district or national performance, tracking over time, recognizing areas of weakness in instruction or curriculum, modifying instruction and curriculum for student needs, assessing the impact of programs, and comparing institutional performance with similar peers.

Academic decision support is correlated with utilization, but is formally separate. Utilization is the use that is made of assessment information; Decision Support is decision making using assessment information. Decisions or decision inputs include guiding student learning, communicating progress to parents, creating instructional groups, considering retention or promotion, or giving families achievement information. A school can use assessment information to monitor and for curriculum review and can use it in a selective fashion to make decisions related to academic programs. If the two domains are treated as the same then this implementation gap will be hidden.

The difference further diminishes the information asymmetry. Leaders have knowledge about classrooms that excludes aspects of classroom knowledge; Teachers have comparative and policy knowledge that excludes aspects of classroom knowledge; students and parents see the consequences, but not the whole of the reasons behind decisions. Effective dissemination unites them, aligning their partial perspectives. Does not need to share all data points with all actors. Instead, it needs to be role-specific, and is based on a chain of reasoning that can be traced, as well as feedback loops to correct interpretations. Academic decision support is thus technical and relational.

2.4 Intelligence governance, dissemination, and ethics

Governance defines who is accountable for intelligence priorities, data quality, data analysis, access, data interpretation, communication and follow-up. Shared reference points are established through written curricular goals and standards of performance. Dissemination and sense-making capacity is fostered through the following: teacher mentoring, sustained consultation, digital collaboration, and planning time. If this is not the case, assessment outcomes may be left to a small administrative team or be misunderstood between departments. Governance thus relates formal powers and dispersed professional judgment.

Ethics should not be a final option. The professional advice provided by SCIP focuses on legal collection, correct representation, confidentiality and avoiding conflicts of interest. In the educational context these principles are also applicable to bias, explainability, right to challenge high stakes interpretations, data minimization, and privacy. Student records are sensitive, and inequalities can be perpetuated through predictive classifications if factors are not taken into account. Some principles of ethical educational intelligence, therefore, include restricting access, recording data origins, being

able to differentiate between evidence and inference, and not allowing a monitoring system to turn into a surveillance system.

Governance and dissemination can be enabling conditions and not just statistical predictors. They might be indirect, contingent, or hard to measure in a questionnaire that has fewer variations for high-prevalence practices. The framework, then, does not take for granted that, because it is written, a standard or a collaboration program automatically brings about better decisions. These practices offer infrastructure, the quality, participation, authority, and usage of which are all important.

2.5 Capability maturity and sustainable institutional advantage

The maturity models in the CI are used to illustrate the evolution of an information-gathering process from being ad hoc to coordinated, governed and learning-oriented. Oubrich et al. (2018) and Madureira et al. (2023) highlight that adding analytic tools to a process is not enough to make it mature, the other important factors are also evolving at the same time, such as leadership commitment, process definition, resources, culture, dissemination, and evaluation. In the context of education, a low level of maturity means that evaluations are performed but not connected to decisions, an intermediate level of maturity means that there is monitoring of performance and adaptation of selected practices, and an advanced level of maturity means that there is planning, multiple sources, analysis, professional dialogue and transparency in decisions and feedback across cycles.

This paper is not intended to provide a validation of a universal maturity scale. Its profile analysis is able to find empirical configurations in one PISA economy and to describe relative patterns using neutral labels: developing and established capability. These profiles are not intended to be quality rankings. They determine if the scanning, utilization, decision support, and governance practices tend to occur together and the gaps. Sustainable advantage is achieved when they can sustain evidence-informed improvement in the face of changing circumstances and continue to protect the educational purpose and trust of stakeholders.

This is where Calof's (2025) incorporation of CI and foresight applies. Schools require knowledge of what's going on and what's needed. Foresight expands the scope of the accountability discussion from the past to preparedness — which skills will be required by students and what technologies will need to be governed, for example, and which groups might be underserved and what institutional assumptions might need to be challenged? The proposed capability consequently blends monitoring with an organizational learning focus.

2.6 Integrated framework and research expectations

The empirical framework focuses on four observable organizational bundles. Environmental scanning includes internal and external evaluation, systematic records, written student feedback and/or tracking of student achievement over a period of time. Intelligence utilization includes benchmarking, teacher effectiveness assessment, progress monitoring, curriculum development, adaptation of students, inter-school comparisons, and improvement. Academic decision support

includes advising on learning, informing parents, retention or promotion decisions, instructional grouping, and/or direct provision of achievement information. Governance and dissemination include written objectives and standards, mentoring, on-going consultation, digital collaboration and planned collective planning.

The expected pattern is a cycle but not necessarily a deterministic one. The more rigorous the scanning, the more likely it is to be used, since a broader and more systematic evidence base provides opportunities for analysis and use. There should also be a direct relationship between scanning and the decision support function: for some evidence, the decision support flow will be immediate, going directly into guidance, communication or grouping. If assessment use is connected with decision support beyond monitoring, there may be an independent association with utilization, but the nature of this relationship will vary based on whether the decisions made are academic or not. Governance is anticipated to complement and enable infrastructure, but ceiling effects and measurement developmental nature may dampen direct effects.

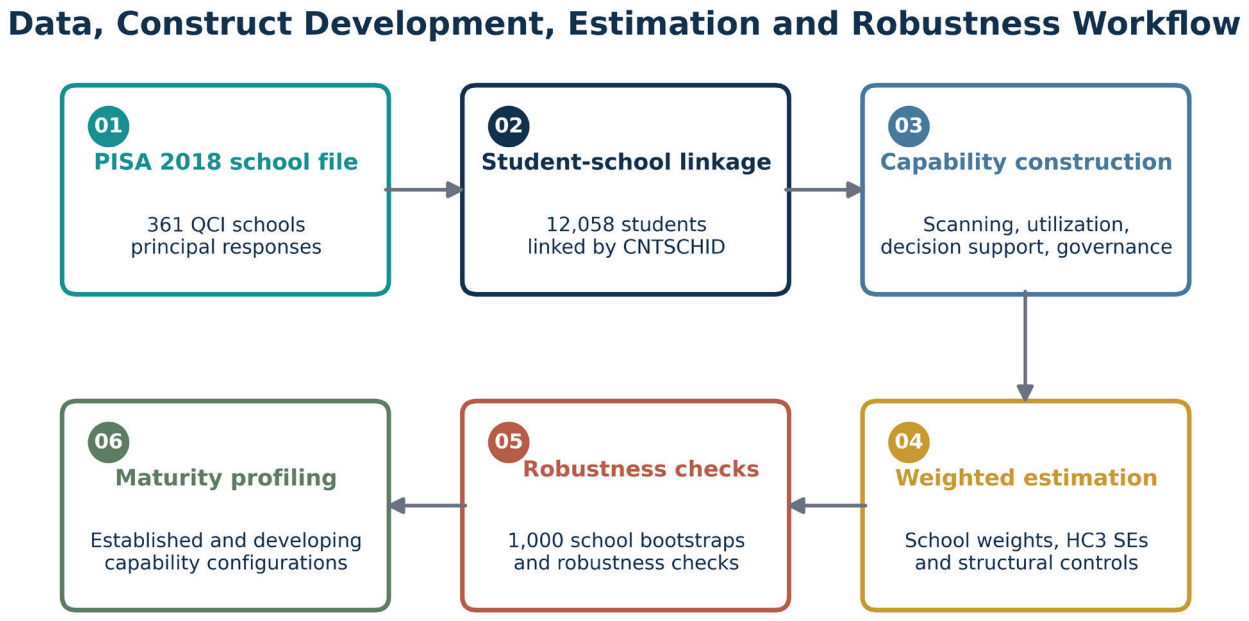
Assessment of these expectations occurs in the context of the three research questions not causal hypotheses. The cross-sectional design cannot determine the sequence of events, and the practice bundles are based on the presence of practices as reported and not necessarily on the level of quality of their implementation. The analytical purpose is to analyse coherence, gaps and robustness in the organisation.

3 METHOD

3.1 Research design

This study adopted a quantitative, cross sectional secondary design, and organizational unit of analysis. The primary data source was the OECD PISA 2018 school questionnaire, which was filled out by the school principal or their representative. The school file was matched with the student file of the PISA using the common school identifier to define student coverage, calculate the school mean socioeconomic context, and confirm that the sample of organisations matched the student sample that participated in PISA. The design explores correlations between reported organizational practices but does not assess the effects of an intervention or causal effects.

Theory-driven analytical sequence. The classical CI stages along with the reviewer's organizational concerns were converted into practice in the candidate schools, variables were labeled, and the answer coding was examined, missingness and variability of variables were examined, and only those variables which could be conceptually aligned defensibly were retained. The workflow from file linkage to construct engineering, weighted models, bootstrap uncertainty, sensitivity tests and capability profiles is summarized as shown in Figure 2.



Organizational constructs are transparent secondary operationalizations of documented PISA school-questionnaire items.

Figure 2. Data linkage, construct engineering, estimation, and organizational interpretation workflow.

3.2 Data source and sample

The school public-use file contained 361 schools for the QCI economy code, representing participating schools in Beijing, Shanghai, Jiangsu, and Zhejiang. All 361 schools matched the student extract, which contained 12,058 students. The main regression sample was 360 schools because one school lacked a required structural control. The analysis used the final school weight (W_SCHGRNRABWT). B-S-J-Z is not a nationally representative sample of mainland China, and the results should not be extended to rural provinces, vocational pathways, younger cohorts, or different governance systems without new evidence.

School-level controls were included to reduce observable structural differences: public versus private status, the linked school mean of the PISA index of economic, social, and cultural status, logged school size, logged student-teacher ratio, shortage of educational materials, and staff shortage. These controls do not remove unmeasured differences in leadership quality, local policy, funding arrangements, or implementation culture.

3.3 Variable operationalization

The 23 practices reported by the principals were grouped into 4 formative bundles. The items selected were formative specification, instead of being a list of alternative expressions of the same latent trait. If student feedback is not used to evaluate the curriculum, then there is no evaluation; and if parental communication is not used to improve the curriculum, then there is no improvement.

It is possible to have more than one practice and this does not imply poor internal consistency, it increases the organizational capability domain.

The dichotomous items were scored 1 for affirmative and 0 for negative responses. The primary coding for quality-assurance items that were coded as either mandatory or school-initiated practice or absence considered the presence of either of those practices. A sensitivity analysis was conducted to examine how conclusions were affected by changes in intensity which had values of 1 for mandatory practice, 0.5 for school-initiated practice, and 0 for absence. For each bundle, the mean of the available items was computed and then each bundle was standardized to the school weight for regression analysis. The exact mapping is given in Table 1.

Table 1. Organizational constructs, PISA indicators, and operational definitions

Construct	PISA indicators	Organizational meaning	Primary coding
Environmental scanning	SC037Q01TA, Q02TA, Q05NA, Q06NA, Q07TA; SC036Q02TA	Internal and external evaluation, systematic administrative and achievement records, written student feedback, and longitudinal tracking	Implemented = 1; absent = 0
Intelligence utilization	SC154Q05WA–SC154Q10WA	Benchmarking, year-to-year monitoring, teacher-effectiveness judgment, curriculum improvement, adaptation to student needs, and inter-school comparison	Yes = 1; no = 0
Academic decision support	SC154Q01HA–SC154Q04WA; SC036Q03NA	Guiding learning, informing parents, retention/promotion, instructional grouping, and direct achievement communication	Yes = 1; no = 0
Governance and dissemination	SC037Q03TA, Q04TA, Q08TA, Q09TA; SC156Q07HA, Q08HA	Written goals and standards, mentoring, sustained consultation, digital collaboration, and scheduled collective planning	Implemented = 1; absent = 0
Structural controls	SCHLTYPE, linked ESCS, SCHSIZE, STRATIO, EDUSHORT, STAFFSHORT	Ownership and school context used to reduce observable compositional differences	Documented PISA coding; continuous controls standardized

Note. The construct names are theory-led secondary operationalizations and are not official OECD competitive-intelligence indices. Exact item labels are retained in the analysis package.

3.4 Statistical procedures

Weighted descriptives summarized bundle prevalence, dispersion, and item-level practice rates. Weighted Pearson correlations described bivariate coherence. Variance inflation factors assessed redundancy. Cronbach's alpha was not used as a threshold for the formative bundles. Measurement evidence was limited to transparent item mapping, practice prevalence, domain separation, and low multicollinearity.

Two school-weighted least-squares models were estimated with HC3 heteroskedasticity-robust standard errors. Model 1 related intelligence utilization to environmental scanning, governance and dissemination, and structural controls. Model 2 related academic decision support to environmental scanning, intelligence utilization, governance and dissemination, and the same controls. The four focal bundles were standardized. One thousand school-level bootstrap replications were used for the direct and indirect components of the scanning-to-decision-support association.

Robustness checks removed weights, removed structural controls, used intensity coding for mandatory and school-initiated practices, and capped extreme school weights at the 99th percentile. Weighted k-means produced two descriptive capability configurations from the four unstandardized bundles. The silhouette coefficient was .363. These checks assess analytical stability. They do not provide external organizational validation. No expert panel, Delphi process, interviews, or previously validated CI instrument was used.

3.5 Ethical considerations

The study did not have direct involvement with students, families, teachers, or principals, rather it was an analysis of secondary data from the public use version of the data. The manuscript does not include an institutional approval/exemption number which was not supplied. Secondary data research should be in accordance with the authors' institution's requirements prior to submission. The structure of the document is substantive addressing the principles of intelligence ethics: data should be collected for educational purposes, access should be keyed to role, decisions of high importance should be explainable and contestable, and monitoring should not be more than is proportionate to the educational need.

Only variables that were available in the files were used, the geographic restriction was reported, formative vs. validated scales were differentiated, non-significant estimates were retained, and association was separated from causation. There is an audit trail in the form of the complete code, item mapping, derived tables, and figure sources.

4 RESULTS AND DISCUSSION

4.1 Organizational practice profile

All 361 QCI schools had sufficient information to calculate the four organizational bundles. Table 2 shows high weighted means for environmental scanning (.920), intelligence utilization (.911), and governance and dissemination (.896). Academic decision support was lower (.700) and more uneven. The contrast is substantively important: participating schools reported extensive monitoring, assessment use, written standards, and collaboration, but the translation of information into selected student-level decisions was less comprehensive. High means also imply ceiling effects, especially for scanning and utilization, which can attenuate relationships and make presence an imperfect proxy for quality.

The item level rates in Table 3 and in Figure 3 explain the strong and weak points of the cycle. Over 97% of the weighted school population reported using internal evaluation, administrative recording, achievement recording, adapting teaching and guiding student learning. External assessment was also prevalent. In contrast, 20.7% said they used assessment results for retention or promotion decisions, 71.3% directly shared achievement data with parents, 73.2% said an external authority monitored achievement over time and 73.2% said they tracked achievement over time. These lower rates do not necessarily imply deficiencies; different retention policies are in place and desirable

levels of restraint may be appropriate. However, they show that monitoring isn't equal to equal decision use.

The pattern is similar to an information rich system with selective conversion, from a CI perspective. Internal monitoring is in place and external monitoring is part of the institutional framework, and dissemination and high-stakes decision applications are more differentiated. It is therefore important that managers audit not only if there is any data but what decisions are supported, who receives analysis and what is the feedback (return) to the next planning cycle.

Table 2. Weighted descriptive statistics for organizational practice bundles

Construct	Items	N	Weighted mean	Weighted SD	Range
Environmental scanning	6	361	.920	.116	.500–1.000
Intelligence utilization	6	361	.911	.147	.333–1.000
Academic decision support	5	361	.700	.166	.200–1.000
Governance and dissemination	6	361	.896	.165	.167–1.000

Note. Means represent weighted proportions of documented practices within each formative bundle. Values summarize presence, not implementation quality.

Table 3. Selected organizational practices across the educational intelligence cycle

Selected practice	CI stage	Weighted prevalence
Internal evaluation/self-evaluation	Collection and analysis	98.3%
Systematic achievement-data recording	Collection	97.8%
Written student feedback on lessons, teachers, or resources	Collection and feedback	95.7%
Monitoring school progress from year to year	Analysis and utilization	93.9%
Identifying curriculum or instruction for improvement	Analysis and utilization	99.9%
Adapting teaching to student needs	Utilization	99.0%
Guiding students' learning	Academic decision support	99.9%
Grouping students for instructional purposes	Academic decision support	85.6%
Providing achievement data directly to parents	Dissemination	52.6%
Using results for retention or promotion	Academic decision support	20.7%
Regular consultation for school improvement	Governance and learning	71.3%
Scheduled collaborative planning time	Governance and dissemination	87.9%

Note. Percentages use the final school weight. Lower prevalence can reflect policy design as well as capability gaps and should be interpreted in context.

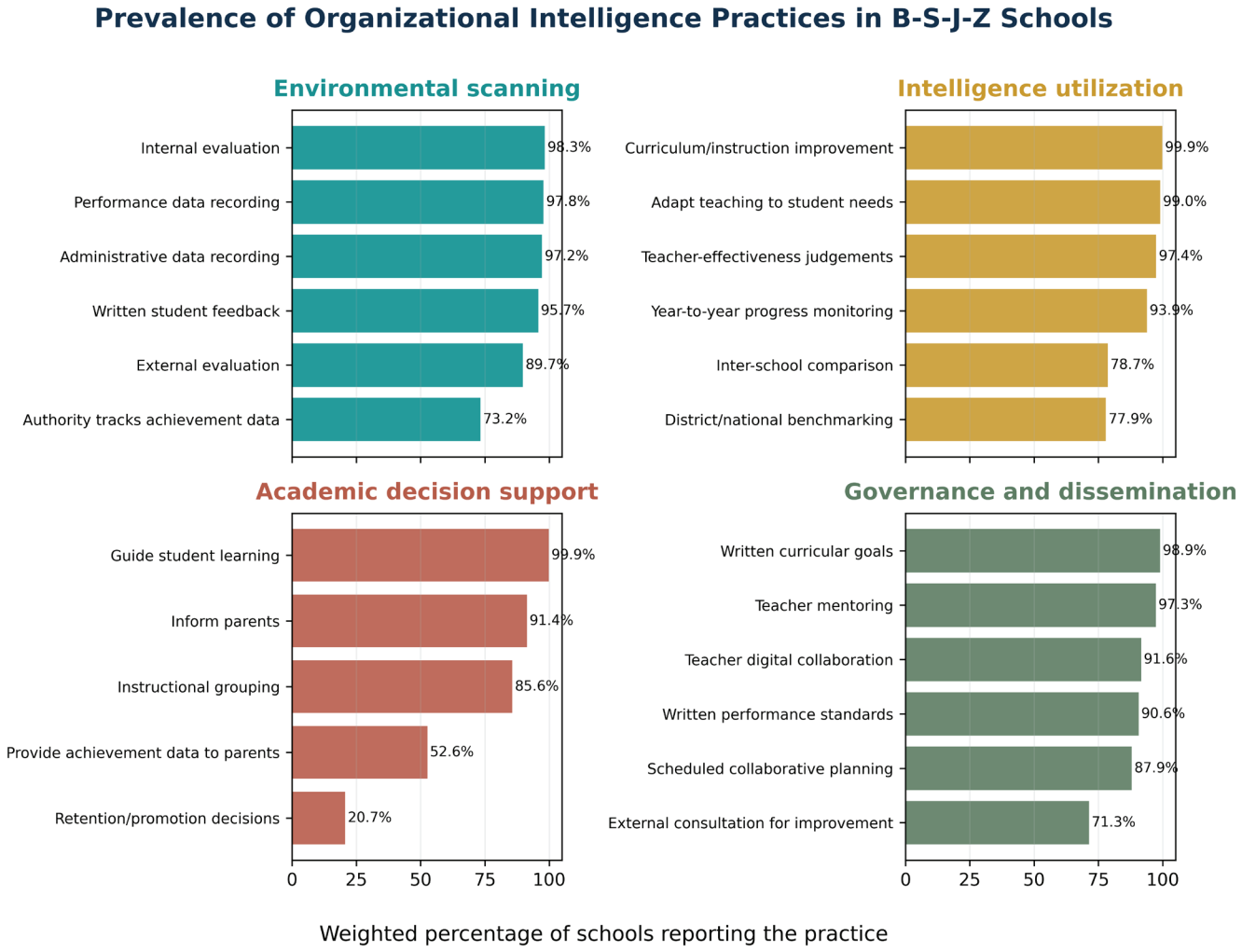


Figure 3. Weighted prevalence of selected school practices across the educational intelligence cycle.

4.2 Construct coherence and information architecture

The weighted correlations in Table 4 show that environmental scanning was moderately related to intelligence utilization (r = .446) and academic decision support (r = .423), and somewhat related to governance and dissemination (r = .336). Intelligence utilization was positively related to academic decision support (r = .321). Governance and dissemination had only a small correlation with decision support (r = .169) and was essentially unrelated to utilization (r = .008). VIFs ranged from 1.052 to 1.332, indicating that the four bundles were not redundant.

This pattern supports a differentiated architecture. Scanning is the connective component: schools that report broader evaluation and recording practices also tend to report more uses of assessment and more decision-support applications. Utilization and decision support overlap but remain distinct. Governance practices are widespread yet weakly coupled to the other bundles. One interpretation is that formal goals, mentoring, collaboration, and consultation are necessary infrastructure but vary less than the quality with which they are enacted. Another is that the selected

governance items capture general professional organization rather than the specific routing, ownership, and accountability of intelligence products. Future instruments should measure who commissions an analysis, who approves its interpretation, how access is controlled, and whether decisions are followed up.

The low VIFs are appropriate for formative construction. They show that the bundles are distinct and not severely collinear. They do not establish construct validity or external organizational validity. The four bundles are theory-driven secondary operationalizations, not a validated educational CI scale. External validation requires expert review, cognitive interviews, pilot testing, and cross-cultural measurement.

Table 4. Weighted correlations and multicollinearity diagnostics

Construct	Scanning	Utilization	Decision support	Governance	VIF
Environmental scanning	1.000	.446	.423	.336	1.332
Intelligence utilization	.446	1.000	.321	.008	1.211
Academic decision support	.423	.321	1.000	.169	1.118
Governance and dissemination	.336	.008	.169	1.000	1.052

Note. The bundles are formative. VIF, content coverage, and transparent item mapping are more appropriate diagnostics than a single internal-consistency threshold.

4.3 Environmental scanning, utilization, and academic decision support

Model 1 explained 33.0% of weighted variance in intelligence utilization. Environmental scanning had a positive association with utilization (B = .481, HC3 SE = .102, 95% CI [.281, .680], $p < .001$). The school bootstrap interval [.328, .646] confirmed that this relationship was not driven by a small number of schools. Governance and dissemination did not have an independent association after scanning and structural controls were included (B = –.114, p = .272). The estimate for public-school status was positive and marginally precise, but ownership was not a primary theoretical variable and should not be interpreted without attention to institutional context.

Model 2 explained 25.7% of weighted variance in academic decision support. Environmental scanning retained a positive direct association (B = .358, HC3 SE = .077, 95% CI [.206, .509], $p < .001$), with a bootstrap interval [.198, .500]. Intelligence utilization was positive but not statistically distinguishable from zero in the baseline specification (B = .167, 95% CI [–.082, .416], p = .190). Governance and dissemination were also imprecise (B = .029, p = .712). The direct scanning coefficient was therefore more stable than the incremental utilization coefficient when all bundles and controls were considered simultaneously.

Figure 4 displays the standardized focal paths. The result does not mean that utilization is unimportant. Its bivariate correlation with decision support was positive, and the construct describes practices that are central to organizational intelligence. The baseline model asks a stricter question: among schools with similar scanning, governance, ownership, socioeconomic context, size, staffing, and material conditions, does reported utilization add a reliably separable contribution to decision support? In these data, the estimate is positive but uncertain. This nuance is central to

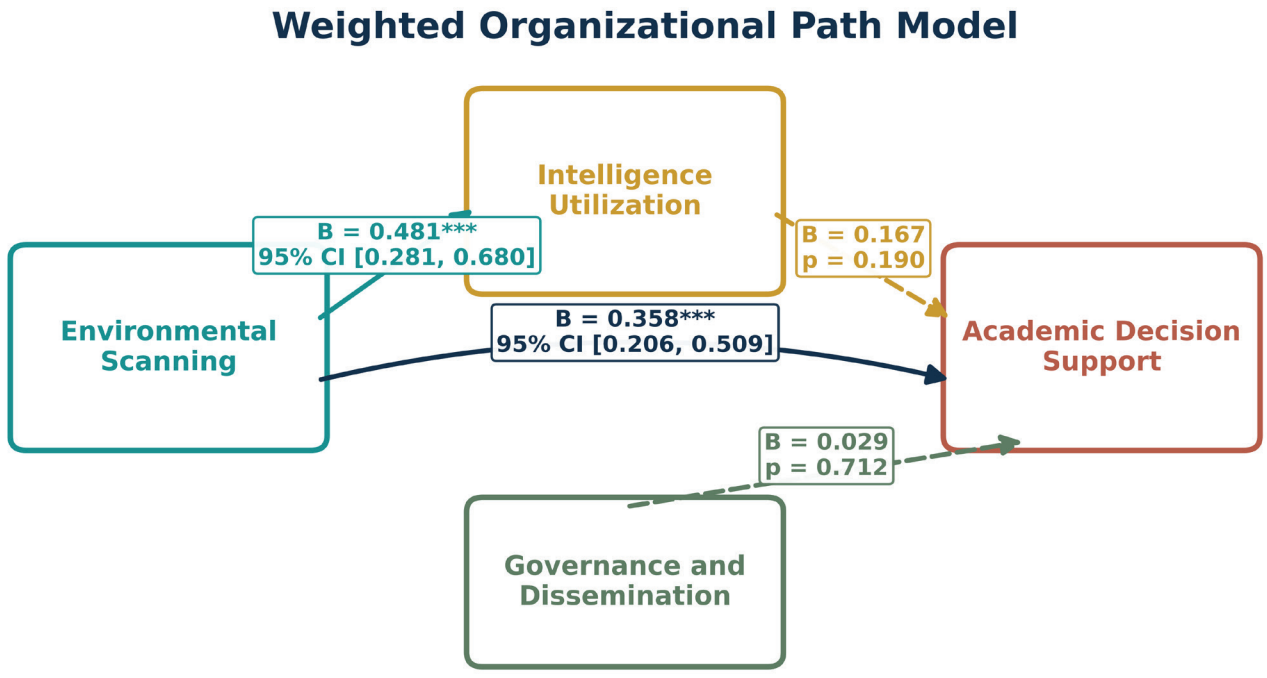
the organizational interpretation. A school can report benchmarking and curriculum use while the decisive link to grouping, parental communication, retention, or learning guidance depends on local rules, role authority, or implementation quality not measured by the survey.

The public-school coefficient in the decision-support model was negative and narrowly precise (B = −.517, p = .047). Because the sample contains a small number of private schools and ownership structures differ across jurisdictions, the estimate should be treated as an adjustment term rather than evidence of sector superiority. The organizational framework concerns transferable routines, not institutional ranking.

Table 5. Main school-weighted organizational models

Outcome and path	B	HC3 SE	95% CI	p	N	Model R^2
Utilization: scanning → utilization	.481	.102	[.281, .680]	< .001	360	.330
Utilization: governance → utilization	−.114	.104	[−.318, .090]	.272	360	.330
Decision support: scanning → decision support	.358	.077	[.206, .509]	< .001	360	.257
Decision support: utilization → decision support	.167	.127	[−.082, .416]	.190	360	.257
Decision support: governance → decision support	.029	.079	[−.126, .184]	.712	360	.257

Note. Models include public/private status, school mean ESCS, logged school size, logged student-teacher ratio, educational-material shortage, and staff shortage. HC3 standard errors are heteroskedasticity robust.



Controls: school ownership, mean ESCS, school size, student-teacher ratio, material shortage and staff shortage. *** p < .001.

Figure 4. Estimated organizational pathways from environmental scanning to intelligence utilization and academic decision support.

4.4 Bootstrap decomposition and sensitivity analysis

The product of the scanning-to-utilization and utilization-to-decision-support paths was .080. Its 1,000-replication school-bootstrap interval [–.021, .180] included zero. The direct scanning-to-decision-support component remained positive, whereas the indirect component was not sufficiently precise to support a sequential mediation claim. Because the data are cross-sectional, even a narrow interval would describe a statistical decomposition rather than temporal mediation. The correct conclusion is that scanning has a robust direct organizational association with decision support, while the hypothesized conversion through utilization requires stronger measurement and longitudinal evidence.

Table 6 shows that the central scanning results were stable. The scanning-to-utilization coefficient ranged from .372 to .500, and the direct scanning-to-decision-support coefficient ranged from .268 to .353 across alternative weighting and control choices. The utilization-to-decision-support path remained non-significant in the unweighted, no-control, and capped-weight models. It became positive and significant only under the intensity coding that distinguished mandatory practices from school-initiated practices (B = .232, p = .031). This result suggests that implementation form contains information lost when both categories are coded simply as present.

The sensitivity result also illustrates a measurement lesson. A binary practice inventory is useful for mapping coverage but can mask institutional depth. A future educational CI instrument should assess frequency, decision relevance, analytical sophistication, responsible owner, dissemination route, perceived usefulness, follow-up, and evidence of change. Such measurement would allow a stronger test of CI maturity and would reduce the risk that formal compliance is mistaken for operational capability.

Table 6. Robustness of the organizational pathways

Specification	Scanning → utilization	Scanning → decision support	Utilization → decision support	Governance → decision support
Baseline weighted + controls	.481***	.358***	.167	.029
Unweighted + controls	.445***	.305***	.066	.082
Weighted, no structural controls	.500***	.325***	.175	.059
Mandatory/initiative intensity coding	.372***	.268**	.232*	.034
School weights capped at 99th percentile	.471***	.353***	.153	.034

Note. * p < .05. ** p < .01. *** p < .001. The baseline indirect scanning → utilization → decision-support estimate was .080, with a 95% school-bootstrap interval of [–.021, .180].

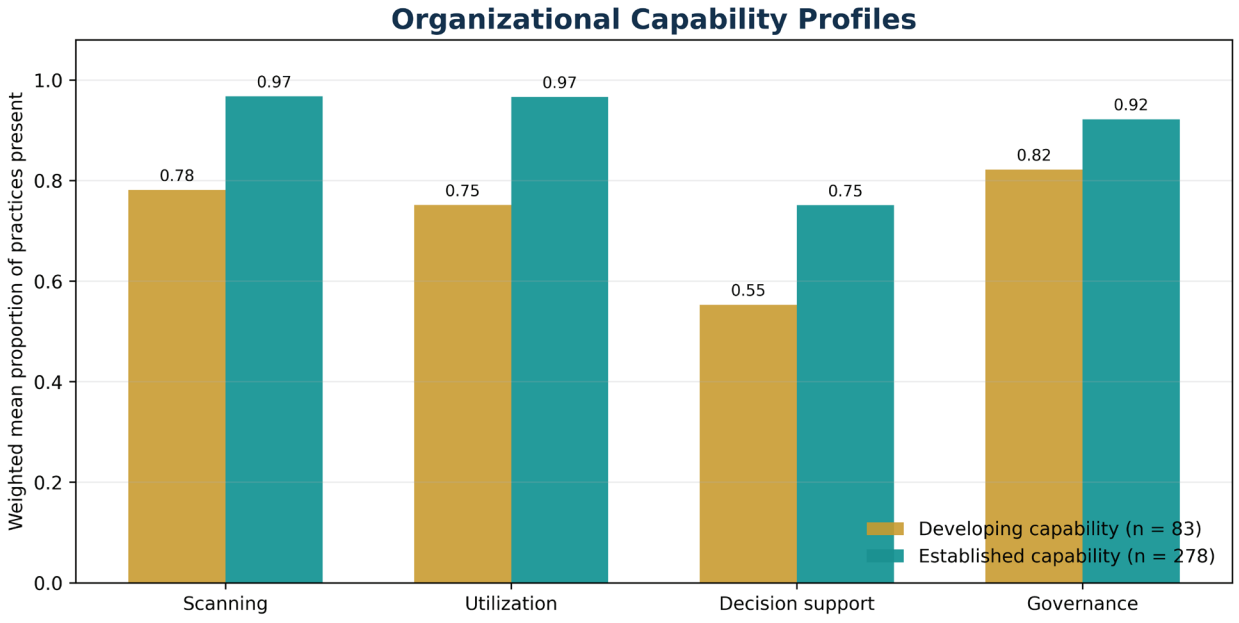
4.5 Capability configurations

The profile analysis identified two interpretable organizational configurations. The established-capability profile included 278 schools and represented 74.4% of the weighted distribution. Its mean practice proportions were .968 for scanning, .966 for utilization, .751 for decision support, and .922 for governance. The developing-capability profile included 83 schools and represented 25.6% of the weighted distribution, with corresponding means of .781, .751, .553, and .822. Figure 5 shows that

the largest absolute profile differences concerned scanning, utilization, and decision support, while governance was high in both groups.

The profiles are not intended to be static snapshots nor as an assessment of the school's effectiveness overall. They indicate relative configurations of reported practices. Even with a lot of monitoring and use, a decision profile is not fully covered, as is evident from the established profile still needing improvement in decision support. The developing profile was not a missing piece of information, as the other domains were all above .55, with the governance domain reaching .82. The management value is in diagnosis targetedness. A school can match its practice map against the four domains and guess which is the most constricted point, and then consider if it is policy, moral, capacity or poor information flow.

The profile pattern is also helpful to understanding sustainable CI maturity. Maximizing all uses of data is not likely to ensure sustainable capability. It involves making choices about evidence use that make sense and provide a legitimate sense of addition, having open avenues for professional challenge, and not falling into the trap of automatic high stakes classification. A mature educational organization may make a conscious decision to refuse certain uses if the validity and/or fairness is inadequate.



Two-cluster solution; silhouette coefficient = 0.363. Profiles describe configurations, not causal stages.

Figure 5. Weighted organizational practice profiles across the four capability domains.

4.6 Managerial, governance, and policy implications

For the education manager, the framework offers a framework of an intelligence cycle audit, not another performance score. Planning questions: What evidence is needed and what uncertainties are relevant in the academic decision-making? Collection questions include: Are internal, external,

administrative, achievement, student voice, teacher judgment, and family information sufficiently integrated? Analysis questions the people that interpret the evidence, the comparisons that are valid, and the resolution of conflicting signals. Dissemination asks for the receiving party to be given information, but not what is appropriate for their role. Utilization asks Who/what decisions were made and why. Feedback questions about what occurred after implementation and if there was any updating for the next cycle.

The results suggest that particular attention should be paid to scanning as it was the most stable organisational predictor. This is not to suggest that more should be collected indiscriminately in schools. Managers should focus on enhancing source coverage, enhancing quality assurance, enhancing longitudinal comparability, and phasing out low value reporting of student feedback in writing. A key–intelligence–topic approach can help to avoid overload: leadership teams first determine what they consider the few key decisions, what evidence is required to support them, who is responsible for them, and when they should be reviewed. This is more focused than having data teams create generic dashboards.

The path from utilisation to decision-support is not clear, and so the focus is on the handoff between analysis and authority. There may be formal decision processes that need to be established in the school that specify who can take action on assessment evidence, what corroboration is needed, how the contextual information is taken into account and how those who are affected by the decision are informed. Professional-development programs should be integrated, having both curricular and pedagogical components and incorporating data interpretation. Collaboration time for teachers is effective when it is linked to a specific decision, and a subsequent cycle.

Governance should mitigate information asymmetry but not lead to unlimited access to information. Patterns need to be aggregated, teachers need information for the class, students need some understanding of their progress, and parents need explanations that are accurate. The sharing of data should be governed by purpose, minimum necessary access, retention, correction and appeal data-sharing rules. The use of automated risk labels should not supplant professional interpretation and predictive accuracy should not be interpreted as permitting. These measures ensure the legitimacy and enhance the chances that stakeholders will provide true information in future cycles.

Institutional learning and institutional data submission should also be assessed in accountability systems at policy level. The local interpretation can be provided, with support from authorities, in the context of common definitions, infrastructure, analytic training, and cross-school learning. Also, the low prevalence of a practice does not mean that it is failing: retention decisions, for instance, rely on legal and educational philosophy. Sustainable competitive advantage in education is the capacity to make better justified, timely, equitable and learnable decisions under varying conditions, rather than to make more data-informed decisions than another school.

5 FINAL CONSIDERATIONS

The purpose of this study was to build an organizational model of the concept of educational CI capability and to conduct observation of the component of the educational CI capability in 361 B-S-J-Z

schools for 12,058 students. The framework is not based on the classroom metaphor – it takes CI out of the classroom into institutional capacity building: planning, environmental scanning, collection, analysis, dissemination, utilization, feedback, governance, ethics and academic decision support. The practices of the PISA do not measure each of these steps directly, but offer an explicit base of empirical observations to question the coherence of monitoring, assessment use, organizational infrastructure and academic decisions.

The educational organization is given as the unit of intelligence capability, the theoretical contribution. Students' online search wasn't the only aspect of environmental scanning, it was also evaluated, recorded, reported back to the student, and tracked over time. No assumptions were made that governance automatically impacts there was a separation between utilization and decision support. Sustainable advantage is also described as organisational learning, as a responsible adaptation, as a stakeholders' trust, not as a competition in the lecture hall.

The methodological contribution is to link school and student files, to make the precise practices reported from principals, to incorporate the school bundles as formative, to incorporate school weights and robust errors, to not drop the n.s. indirect effect and to test multiple specifications, and to specify capability configurations. The analysis illustrates the reasons for having a transparent, rather than a named, secondary operationalization, instead of an unvalidated proxy as a CI scale. It also demonstrates that binary practice measures can be used to determine coverage but do not measure well the depth of coverage, quality of ownership and follow-through.

The management message is that schools need to conduct an audit of the whole intelligence process. The process of academic decision support was not always as extensive in the schools that were included and was not always easy to see how the material would be used. Although a high level of monitoring and assessment usage was reported across participating schools, academic decision support was not as well developed and there was not always a clear incremental utilization pathway in the primary model. Leaders should focus on aspects of conversion; decision needs, analytical ownership, aspects communicated with respect to people's roles; authority to act; ethical protection; and feedback after implementation. Capability profiles can be used to inform internal diagnosis but are not intended to be used for ranking.

Several limitations remain. The design is cross-sectional and direction and causality cannot be inferred. This is a sample rather than a representative sample of four relatively well-developed jurisdictions in China. There are ceiling effects on some items. The presence of practice is recorded in Principal reports, not necessarily the quality of the practice. The governance bundle is not sufficient to assess intelligence ownership or ethical practice. Above all, there was no organizational validation from the outside. There are no experts, Delphi panel, interviews or previously validated CI instrument used to assess the bundles. Therefore, these must be understood as being theory-driven secondary operationalisations, not as a validated CI scale. The information in the linked student file is used for context only and not to validate the quality of the organisational decisions. Long-term outcomes were not available.

Further research is recommended to create a dedicated education CI instrument. The panel should feature representation of school leaders, teachers, CI scholars, data-governance professionals, students and families. The Delphi technique can be used to evaluate content relevance and define

the limits of the CI stages. These should be followed by cognitive interviews and pilot testing. Measurement quality should then be tested in multi level and cross-cultural studies. For longitudinal designs, follow a flow of a decision from planning and collection, through analysis, dissemination, action and feedback. National, rural, vocational and lower resource settings should also be included in research.

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Author Contributions: Conceptualization: Shu Zhang and Anuar Ahmad; data source identification and curation: Shu Zhang and Anuar Ahmad; formal analysis and interpretation: Shu Zhang; writing—original draft: Shu Zhang; writing—review and editing: Anuar Ahmad and Jamsari Alias; supervision: Jamsari Alias. All authors have read and agreed to the final version of the manuscript.

Data Availability: The study uses the OECD PISA 2018 public-use school and student questionnaire files. The analytic sample is the QCI economy code representing Beijing, Shanghai, Jiangsu, and Zhejiang. The accompanying analysis package contains the code, item mapping, derived tables, and figure sources; the underlying OECD files remain subject to OECD documentation and terms.

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