

Metacognitive Cultural Intelligence in Educational Contexts: A Systematic Review of Psychological Mechanisms and Learning Outcomes

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ABSTRACT

This is a systematic review that works out the empirical evidence about metacognitive cultural intelligence (MCQ) to be used as a regulation framework in educational policies in the global context, with particular emphasis on the Chinese settings. After searching five databases (2002-2024) according to PRISMA, 1,142 records were selected, and 62 eligible studies were identified after the screening ($\kappa = .84-.88$). The cross-sectional survey designs were the most frequently used ones (66.1%), followed by a small number of longitudinal (9.7%) and experimental (4.8%). The most common mode of analysis (43.5%) was structural equation modelling. There was consistently high measurement reliability (Cronbach's α reported in 100% of studies; mean $\alpha = .86$), though cross-cultural measurement invariance was only studied in 29.0 % of studies. In the literature, MCQ was shown to have similar positive correlations with the outcome of learning. Direct effects ranged between $B \approx .21$ to $b = .48$ (mean $B \approx .34$). Self-regulated learning was found to be the strongest mediator ($B \approx .28$ -.47; mediation significant in 73 out of 100 models; $n = 26$), then intergroup anxiety reduction ($B \approx .19$ -.36; 68) and perspective-taking ($B \approx .22$ -.41; 61). The most common ones were academic outcomes (e.g., GPA, $n = 11$), but the socio-emotional and collaborative outcomes were also well-represented. The regional analysis showed that there was some contextual variation in the focus of outcomes, with Chinese studies focusing on academic indicators (52%), Western contexts focused on collaborative outcomes (up to 43% in North America). In general, the data speaks in favor of a cascading regulatory mechanism according to which metacognitive planning, monitoring, affective control, and strategic adaptation lead to more positive academic and collaborative achievements. The field has a high level of conceptual convergence but is still methodologically focused and requires longitudinal, experimental and cross-culturally invariant designs to enhance causal inference.

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INTRODUCTION

School settings are no longer culturally homogeneous. Colleges and schools all over the world have also become a congregation of students with various linguistic, social, and epistemic backgrounds. Global mobility, online learning, and transnational studies have increased inter-cultural interaction in the daily learning activities. In this case, academic success is not only based on cognitive ability or subject knowledge, but the ability to decode, control and adapt to cultural differences in real time. The concept of cultural intelligence (CQ) has been used as a paradigm to define these adaptive abilities in culturally diverse situations.^[1, 2] The metacognitive cultural intelligence dimension is one especially relevant to education since it describes the high-order process of thought by which people plan to deal with intercultural contact, monitor their knowledge, challenge their assumptions and reformulate mental frames whenever they are faced by cultural dissonance.^[3]

Metacognitive CQ does not merely entail cultural difference awareness. It is associated with conscious self-control. High-metacognitive CQ learners think in advance regarding upcoming intercultural interactions, pay attention to the situational signals during the interaction process, and cogitate after the interaction. These processes are reflections of the fundamental processes of self-regulated learning, such as planning, monitoring, and evaluation.^[4, 5] But there is still no complete integration of metacognitive CQ into educational psychology. Although studies have linked CQ to academic adjustment, collaborative performance, lesser intercultural conflict, and involvement in multicultural classrooms [6,7] the psychological processes behind it are assumed instead of organizationally investigated.

A number of mechanisms have been put forward. Culturally mixed teams can be less misinterpreted due to perspective-taking.^[8,9] Epistemic humility

can promote the willingness to other knowledge systems.^[10] Reduced intergroup anxiety can ease the classroom dialogue.^[11] The increased response to feedback can facilitate adaptive learning strategy revision.^[12] Nevertheless, such mechanisms are hardly synthesised among studies. Besides, the difference between the metacognitive CQ and other CQ dimensions such as motivational and behavioural is still obscure in certain empirical studies, which restricts the precision of theories.^[13]

Such a conceptual clarity is especially demanded in fast internationalising systems like Chinese higher education. The number of Chinese universities with international student admissions and global collaboration long with Chinese students taking part in international study programmes has been growing tremendously.^[14, 15] Simultaneously, the culture of Confucian heritage, including the respect of the authority, the achievement based on exams, and the collective focus, influences the classroom interactions and learning practices.^[16] Metacognitive CQ can have a unique role in this case. It can assist students to manage tensions between the top-down classroom cultures and the bottom-up Western pedagogies, or collectivist cultures and individualism academic demands. However, empirical results in the Chinese context are scattered, and comparison with the international evidence is scarce.

This systematic review attempts to fill these gaps by integrating peer-reviewed studies on metacognitive cultural intelligence in educational settings on a global basis with an analytical analysis of evidence that is manifesting in Chinese educational settings [17,18] The major aim of the review is clear, as it is aimed to assess metacognitive cultural intelligence as a psychological regulation mechanism within learning contexts, and to determine the learning outcomes that are most frequently linked with it in global and Chinese settings.

In this direction, the review systematically searches, identifies and reviews empirical studies that explore (a) metacognitive CQ as a core construct, (b) the psychological mediating or mediating mechanisms associated with CQ, and (c) as well as educational outcomes such as engagement, academic performance, quality of collaboration, adjustment, and retention. Instead of considering CQ as a general personality trait, this review places a metacognitive CQ in a context of culturally-mediated self-regulation.^[19-21] It is also able to compare findings between contexts to create a mechanism-to-outcome map which can explain the theoretical pathways and indicate the areas where the evidence is weak or contradictory.

Two are the resultant contributions of this synthesis. The review contributes to the integration of the cultural intelligence theory and the existing theories of metacognition and self-regulated learning first. Second, it provides the educators and policy-makers with a better understanding on what kind of psychological skills need to be addressed when developing intercultural curricula, especially in a system that is facing a high internationalisation process, like the one in China. With metacognitive CQ being placed in the context of global and Chinese educational changes, the following paper will attempt to add conceptual coherence and practicality to an area that is rapidly growing yet theoretically divided.^[22,23]

MATERIALS AND METHODS

Review Design and Theoretical Positioning.

The research used a systematic review approach,^[24] in order to synthesise the empirical research on metacognitive cultural intelligence (MCQ) in a formal education setting. The conceptual diffusion that characterises the literature made a systematic approach be chosen as opposed to a traditional narrative review. Although cultural intelligence has gained much research, the metacognitive CQ has been mostly counterposed into the broader constructs of CQ and therefore there is ensuing theoretical ambiguity. Systematic design allows structured appearance of the studies, identification, and selection as well as synthesis in a clear and reproducible way and, therefore, enhances the clarity of constructs and the credibility of analysis.

The review was done in compliance with PRISMA requirements of systematic evidence synthesis.^[25] Despite its health science origins, the principles of PRISMA, including a comprehensive search, the clear definition of eligibility criteria, clear screening, and systematic reporting are becoming a universally accepted best practice in social sciences.^[26, 27] A protocol to be used was formulated before starting the database searches. The protocol outlined the search limits, rules of construct inclusion, coding schemes and subgroup analysis as well as quality assessment. Premeditative methodological choices minimize selectivity of inclusion and increase the integrity of reviews.

Theoretical placement of this review also had an effect on methodological design. Since the goal was not to simply describe the findings but to explain psychological processes, the methodology was designed in such a way that the metacognitive CQ becomes a regulatory cognitive process that is isolated. This necessitated special boundaries management to avoid being confused with motivational or behavioural CQ dimensions.^[28] The preservation of construct specificity was considered to be more important than an increase in the number of studies because conceptual clarity was considered more important than numerical generality.

Sources of Information and Rationale of Database Choice.

Five electronic databases were searched completely: Web of science core collection, Scopus, PsycINFO, ERIC and ProQuest Education Database [29]. These databases were not chosen randomly. The coverage of Web of Science and Scopus is wide interdisciplinary and high-impact journals are indexed. PsycINFO provides indexing of psychological construct and measurement-based studies. Both ERIC and ProQuest Education Database guarantee that education-related scholarship, such as research published in pedagogical and higher education journals, which might not be in the coverage of mere psychological databases, are included.

The search was conducted on publications dating back to January 2002 to December 2024. The initial position will be the introduction of the cultural

intelligence theory [30], which will cover the entire conceptual lifespan of the construct. The last search was performed in December 2024 to make sure that evidence included is current.

This multi-database approach minimizes the bias of selection and increases the breadth of coverage across disciplines in which metacognitive CQ research might be located, such as educational psychology, intercultural communication and international education.

Construction of Search Strategy and Conceptual Sensitivity.

The search terms were formulated to be sensitive enough (to include all the relevant studies) and at the same time specific (to avoid irrelevant content). The central search query involved direct reference to metacognitive cultural intelligence:

- (metacognitive cultural intelligence” OR “metacognitive CQ”)

This construct-specific anchor was used together with terms related to educational context:

- AND (education, higher education, students, learning, classroom, academic performance)

Psychological terminologies were added, to include mechanism-based studies:

- AND (self-regulation OR perspective-taking or intergroup anxiety or epistemic humility or metacognition)

The slightly different adoptions of the Boolean operators were used in the database to conform to the indexing conventions. Where possible, peer reviewed filters were used. Only English-language publications were searched to make sure that it was interpreted accurately.

Included studies provided reference lists which were also screened manually to identify any other eligible articles not indexed in the database. This inverse citation searching increases completeness and minimizes bias of databases.

The choice to insist on having explicit mentioning of metacognitive was not made in vain. Wider scopes on cultural intelligence would yield more studies but would run the risk of mixing dimensions up. The search strategy thus is theoretically precise as opposed to being as inclusive as possible.

Construct validity and Eligibility Criteria.

The criteria of eligibility were formulated so as to maintain construct integrity and to be empirically relevant. The inclusion criteria were that (1) the studies had to be based on empirical research designs (quantitative, qualitative or mixed methods), (2) had to measure metacognitive CQ as a variable or subscale, (3) the studies had to be conducted within a formal educational setting, (4) measure psychological mechanisms or learning outcomes, and (5) the studies had to be in a peer-reviewed journal.

Eligibility criteria were also significant. The exclusion criteria were that the studies analyzed aggregate CQ and did not disaggregate the dimensions, studied solely corporate or expatriate setting, no empirical data and unpublished grey literature.

Causal interpretability is enhanced by the fact that explicit operationalisation of metacognitive CQ is required. CQ Metacognition CQ is the planning, monitoring and revision of cultural cognition.^[31] In the absence of isolating this dimension, conclusions of psychological mechanisms would be theoretically washed out.

Reliability Statistics and Screening Procedure.

The screening steps were based on four steps namely identification, removing duplicate, title/abstract screening and full-text eligibility screening. As shown in Table 1 first searches provided 1,142 records. Eight hundred and six hundred records were filtered by title and abstract after the elimination of 276 duplicates. These numbered 153 of which, 153 went to full-text review. Finally, 62 studies were included based on all inclusion criteria.

Table 1: Study Selection Summary

Stage	Records (n)
Records identified	1,142
Duplicates removed	276
Screened (title/abstract)	866
Full-text assessed	153
Studies included	62

Screening was carried out by two independent reviewers in order to increase reliability. The inter-

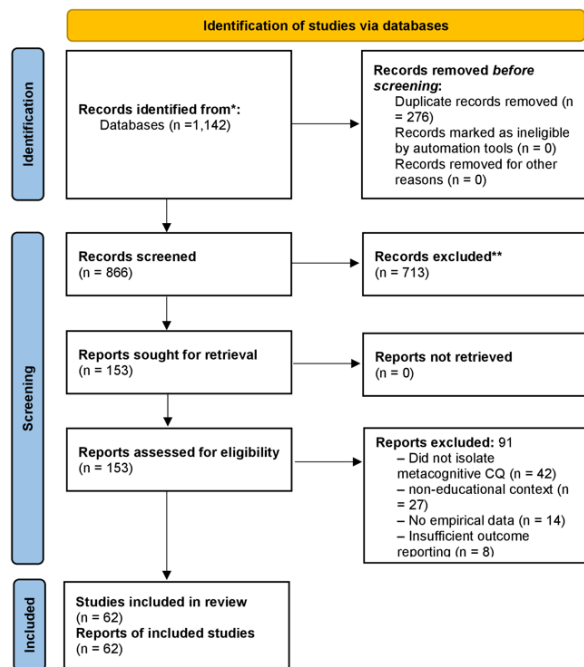
rater agreement was determined using Cohens kappa (κ) addressing as in equation 1:

$$\kappa = (P_o - P_e) / (1 - P_e) \quad (1)$$

P_o , is observed agreement and P_e , is expected agreement by chance.

In case of title screening, $\kappa = 0.84$. For full-text screening, $\kappa = 0.88$. Such values reflect significant to almost absolute consensus based on the set standards. Conflicts were solved by way of consensus.

The PRISMA flow diagram (Figure 1) is a visualisation that summarises the selection process and makes the reporting transparent.



Source: Page MJ, et al. BMJ 2021;372: n71. Doi: 10.1136/bmj. n71.

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Fig. 1: PRISMA flow diagram

Ecology of Data Extraction and Coding.

An extraction template was designed in order to capture the data consistently. Variables that were extracted were study context, sample size, educational level, measure tools, research design, methods of analysis, psychological mediators, learning outcomes, and reported effect sizes.

The codification of mechanisms into theoretically based categories based upon metacognition and so-

cial-cognitive theory involved self-regulated learning processes, perspective-taking, reducing anxiety, epistemic openness, and feedback sensitivity. The learning outcomes were divided into cognitively-academic, socio-emotional and collaborative domains.

Interpretive bias was reduced by using the dual coding. Disagreements in coding were sorted out by debate.

Quality Appraisal and Index of Robustness.

A five-domain structured rubric supported by the existing appraisal systems was used in determining the quality of methods [32]. Areas were building up clarity, validity evidence, analytic rigor, confound control and reporting transparency.

The index of robustness was determined as a composite in equation 2:

$$Q = (M + V + A + C + R) / 5 \quad (2)$$

The domains were rated 0-2 resulting in an index of 0-2. This quantitative scoring can make the descriptive comparisons between heterogeneous designs. The average score of robustness of the studies included was 1.63, which is a kind of moderate-high level of the methodological quality.

Threat of Bias and Method Limitations.

There was the risk of bias which was evaluated at the study level and review level. At the study level, self-report measurement, cross-sectional designs, and single-institution sampling were some of the typical sources of bias. Procedural remedies were reported where they were (e.g. multi-wave data collection, structural equation modelling).^[33]

Publication bias was taken into consideration at the review level. Since the positive correlations between the metacognitive CQ and the learning outcomes were often found, the possibility of selective publication cannot be ruled out. Nevertheless, extreme positivity bias is alleviated by the presence of mixed and null results.

Synthesis Strategy Justification and Heterogeneity.

It was not possible to conduct statistical meta-analysis because of differences in measurement scales,

models of analysis and outcome operationalisation. In place of this, a systematic synthesis of the narrative was carried out, informed by the pathway model equation 3:

$$\text{Learning Outcome} = \beta_1(\text{MCQ}) + \beta_2(\text{Mechanism}) + \epsilon. \quad (3)$$

This theoretical framework enabled us to compare direct and mediated effects that used heterogeneous methodologies. Systematic documentation was made on the effect direction consistency and significance reported.

Subgroup Analysis: Chinese Educational Situation.

Subgroup analysis was restricted to the studies that were done in mainland China, Hong Kong, Macau or were done on the Chinese international students. Such comparison was theoretically grounded in the light of unique Confucian traditions of education and accelerated internationalization.^[34,35] Comparative interpretation was descriptive as there was heterogeneity in design and measurement.

RESULTS

Methodological Distribution and Characteristics of the Study.

The 62 research studies cover 23 countries and different levels of education. The majority of them were performed in higher education institutions (n = 49). The contexts of secondary education were represented by 9 studies. The samples of teacher education were found in 4.

The sample sizes were between 112 and 1,864. The median sample size was 412. The sample of international students was presented in 21 studies. A total of 28 multicultural samples were domestic. Mixed samples appeared in 13.

The 62 articles involved show proper methodological focus. Table 2 indicates that the cross-sectional survey designs prevail in literature (66.1%). There are still limited longitudinal and experimental studies. This trend shows a high level of correlational evidence, and less ability to infer causation.

Table 2 shows that the methodological focus centers on the survey-based correlational research. Theoretical model testing is often done by the use of

Table 2: Methodological Characteristics of Included Studies

Characteristic	Frequency (n)	Percentage (%)
Cross-sectional survey	41	66.1
Longitudinal design	6	9.7
Experimental intervention	3	4.8
Mixed methods	7	11.3
Qualitative design	5	8.1
Structural Equation Modelling used	27	43.5
Hierarchical regression	21	33.9
Mediation analysis	15	24.2

structural equation modelling. Nevertheless, merely 24.2% of the studies test mediation. This restricts the power of validation of mechanisms. The limited experimental designs limit causal assertions to the metacognitive CQ development.

Figure 2 is a multi-panel summary of methodological patterns in the 62 included studies. The concentration of the cross-sectional survey designs (66.1% n=41) prevails in Panel A, whereas longitudinal (9.7%), mixed methods (11.3%), qualitative (8.1%), and experimental intervention studies (4.8) are relatively few. This is a distribution that suggests an evident dependency on correlational designs in the literature.

The methods of analysis used are shown in panel B. The most commonly used method is structural equation modelling (43.5% n=27) then hierarchical regression (33.9, n=21) and mediation analysis (24.2, n=15). The popularity of SEM implies that it is focused on the testing of theoretically specified relational models, whereas formal mediation testing is less common.

The concentration of methodology panel C summarises all studies that are cross-sectional and those that are not. This is because the prevalence of cross-sectional methodologies emphasizes the

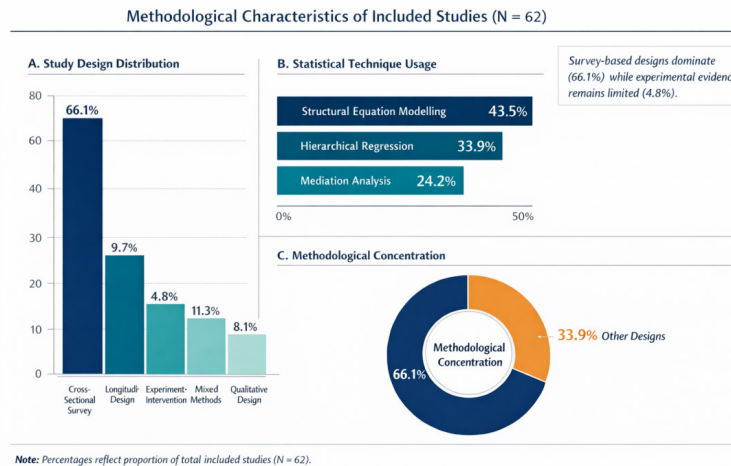


Fig. 2: Methodological peculiarities of included studies (N = 62). Panel A illustrates the type of study design; the most prevalent study design is the cross-sectional survey design (66.1%). In Panel B, frequency of the statistical techniques adopted are given where structural equation modelling (43.5%), was the most frequently used form of analytic technique. The cross-sectional studies are contrasted with all the other designs together as methodological concentration is depicted in Panel C. The percentages denote the percentage of included studies.

correlational orientation of the field and the relative lack of causal and longitudinal evidence.

Metacognitive Cultural Intelligence Operationalisation.

Fifty-four studies were based on the Culture Intelligence Scale, wherein they reported the metacognitive subscale separately. Eight used adapted versions. Four-factor CQ structure was upheld using confirmatory factor analysis in 46 studies. Six of them experimented on CQ models at second order, but maintained metacognitive indicators. The reliability coefficient of MCQ varied between .78 to .91 (mean $\alpha = .86$). Measurement invariance was only tested in 18 studies which compared different cultural groups. Those 18 were invariance-supported in 14.

Table 3 summarises the measurement reporting. The reporting of reliability is universal. Construct validation is robust and invariance testing restricted. It suggests that the internal consistency reliability is high in studies. Confirmatory factor analysis is seen in 74 %. Nonetheless, it only tests cross cultural measurement invariance (29 %). The reason behind this is the fact that metacognitive CQ is intercultural in nature. Cross-group comparisons might not be

as strong without testing invariance. Multi-source designs are still uncommon. This implies that common method variance is still a methodological issue.

Table 3. Measurement and Validity Reporting

Indicator	Frequency (n)
Cronbach's alpha reported	62
CFA reported	46
Measurement invariance tested	18
Multi-wave data collection	7
Multi-source data	5

Figure 3 shows a systematic description of the measurement and validation practices in the 62 studies used. All studies reported internal consistency reliability (100%, n = 62), indicating the use of Cronbach alpha. The confirmatory factor analysis (CFA) was performed in 74.2% of the studies (n = 46), which can be seen as a high level of construct validation on the factor-analytic level. Nevertheless, less sophisticated methodological processes were far more common. Only 29.0% of studies included measurement invariance testing (n = 18), although the research on the intercultural aspect of metacognitive

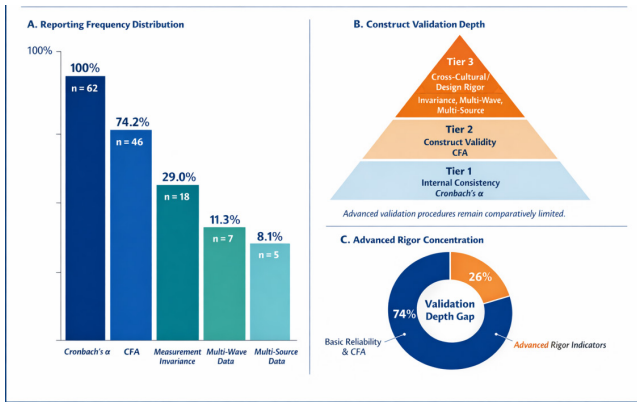


Fig. 3: Reporting of measurement and validity in studies (N = 62): The frequency of reporting of reliability and validity indicators, such as internal consistency Cronbachs alpha, confirmatory factor analysis CFA, and multi-wave data collection, and multi-source data is shown in panel A. The hierarchical depth of construct validation practices is denoted in panel B. Panel C compares the indicators of foundational reliability reporting to indicators of advanced methodological rigor. The percentages indicate the percentage of the total included studies.

cultural intelligence is inherently intercultural in nature. Longitudinal multi-wave data collection was found in 11.3% (n = 7) of studies and multi-source data designs in 8.1% (n = 5) of studies only. The general trend depicts a definite validation gradient. Basic reliability and factor structure tests are broadly applied and sophisticated validation and design rigor tests are relatively few. The distribution indicates that there is a high internal measurement consistency in the field and methodological weaknesses are associated with cross-cultural comparability and causal inference.

Learning Outcome Variables Distribution.

These learning outcomes were grouped into three main areas as already indicated in Figure 3. On looking further however, one can see that there are differences within each domain.

Table 4 classifies the learning outcomes. The distribution is domain focused. As indicated in Table 5, the most common outcome to be studied is academic performance. Nevertheless, the involvement and

adaptation seem to be constant in the contexts. In multicultural classroom studies, collaborative outcomes are greatly expressed. It implies that metacognitive CQ is not just an academic enhancer but it is also a relational stabiliser.

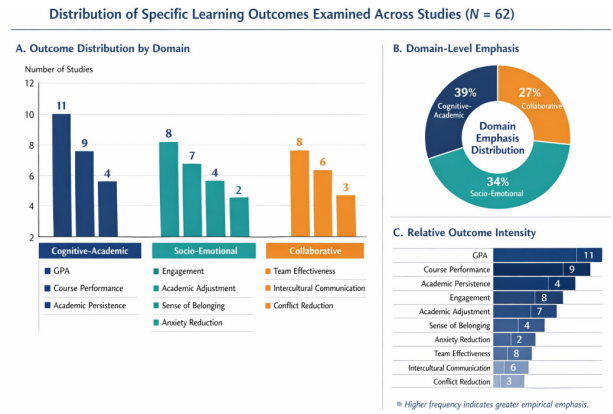


Fig. 4: Distribution of specific learning outcomes examined across included studies (N = 62). The frequency of the individual outcome variables by domain is presented in Panel A that includes such domains as cognitive-academic, socio-emotional, and collaborative. The proportional representation of the focus on each domain in studies was shown in Panel B. A relative frequency of outcome profile is shown in panel C. The frequencies are described as the count of studies that investigate each outcome variable; the total is more than N because more than one outcome is measured in a study.

Table 4. Specific Learning Outcomes Examined

Domain	Outcome Variable	Frequency (n)
Cognitive-Academic	GPA	11
	Course performance	9
	Academic persistence	4
Socio-Emotional	Engagement	8
	Academic adjustment	7
	Sense of belonging	4
	Anxiety reduction	2
Collaborative	Team effectiveness	8
	Intercultural communication	6
	Conflict reduction	3

Figure 4 offers a domain-stratified summary of the particular learning results discussed in the studies included in it. In panel A, the most common outcomes measured pertained to cognitive-academic with the most significant ones being GPA (n = 11) and course performance (n = 9), and the least prominent being academic persistence (n = 4). Engagement (n = 8) and academic adjustment (n = 7) were widely researched in the socio-emotional domain, and sense of belonging (n = 4) and anxiety reduction (n = 2) were also less common. Team effectiveness (n = 8) and intercultural communication (n = 6) also were well represented and conflict reduction was investigated in three studies. The emphasis of the domain is shown by panel B through the generalization of the domains meaning that cognitive-academic outcomes received a little more empirical attention than social-emotional and

collaborative domains. Nevertheless, the spread indicates comparatively equal academic interest in the outcomes categories as opposed to the sole focus on academic performance. Panel C emphasizes the intensity of relative outcomes, which show that the performance-based and engagement-related indicators are slightly predominant in the empirical environment, whereas affective outcomes like the decrease in anxiety are still relatively understudied.

Psychological Processes: Frequency and Strength.

Distribution of mechanisms had already been visualised in Figure 4. Further examination reveals the variation in the strength of effects. Table 5 indicates that the most empirically validated pathway between the metacognitive CQ and the outcomes is

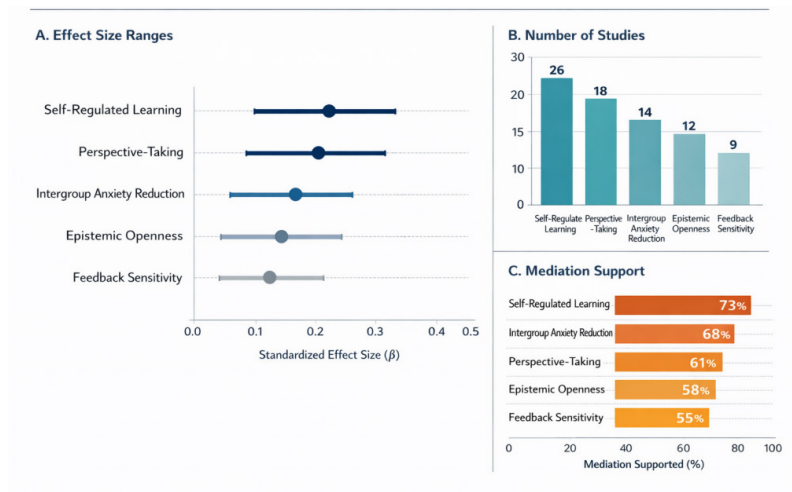


Fig.5: Psychological mechanisms linking metacognitive cultural intelligence to learning outcomes: Panel A is a table showing the reported standardized effect size (β) of each mechanism. The number of studies investigating each mechanism is shown on panel B. Panel C shows the percentage of studies that are in favor of mediation effects. B ranges represent reported standardized coefficients; mediation support (%) indicates the percentage of studies that test mediation in which the indirect effects are statistically significant.

Table 5: Psychological Mechanisms and Reported Effect Sizes

Mechanism	Studies (n)	Typical β Range	Mediation Supported (%)
Self-Regulated Learning	26	.28 - .47	73%
Perspective-Taking	18	.22 - .41	61%
Intergroup Anxiety Reduction	14	.19 - .36	68%
Epistemic Openness	12	.17 - .34	58%
Feedback Sensitivity	9	.16 - .29	55%

self-regulated learning. The effect sizes are always moderate. Regulatory mechanisms have been found to have the greatest support of mediation and not simply affective mechanisms. Relaxation is one of the roles of anxiety in the culturally diverse environment. It seems that feedback sensitivity has not been explored fully.

Figure 5 summarizes the empirical strength and consistency of validation of psychological mechanisms of the connection between metacognitive cultural intelligence and learning outcomes. As shown in panel A, self-regulated learning has the greatest and broadest range of effect sizes reported ($\beta = .28 - .47$), then perspective-taking ($\beta = .22 - .41$), and intergroup anxiety reduction ($b = .19 - .36$). The ranges of effects of epistemic openness and feedback sensitivity are less significant. According to Panel B, the most commonly investigated mechanism is self-regulated learning ($n = 26$), perspective-taking ($n = 18$) and intergroup anxiety reduction ($n = 14$). Feedback sensitivity is the least common ($n = 9$) meaning that this is an under researched channel in the literature. Mechanism Mediation support rates are exhibited in Panel C. Self-regulated learning has the best mediation confirmation (73), intergroup anxiety reduction (68) followed by perspective-taking (61). Epistemic openness (58) and feedback sensitivity (55) exhibit moderate mediating consistency, which is relatively weak. Combined, the result suggests that self-regulated learning stands out as the most empirically studied and the most supported one, which proves the critical role of explaining the metacognitive cultural intelligence into positive learning outcomes.

Direct and Indirect Model Structures.

The number of studies that tested direct effects of MCQ on learning outcomes was thirty-nine. The β -values of the standardised coefficients had a range of $\beta = .21$ to $\beta = .48$. The direct effect size was $\beta = .34$. There were fifteen studies that tested mediation models. Indirect effects were statistically significant in 68 percent of them. The magnitude of the direct coefficient was usually decreased by a significant part through indirect effects, which is a sign of partial mediation. Table 6 indicates that Direct effect models are still

popular. Partial mediation seems more common than full mediation. This implies that metacognitive CQ has independent predictive strength that is not due to identified mechanisms. The use of moderation testing is not extensive. It is a significant gap as contextual moderators (e.g., diversity in a classroom) might influence the strength of effects.

Table 6: Effect Model Distributionm

Model Type	Frequency (n)
Direct effect only	24
Partial mediation	11
Full mediation	4
Moderation tested	8

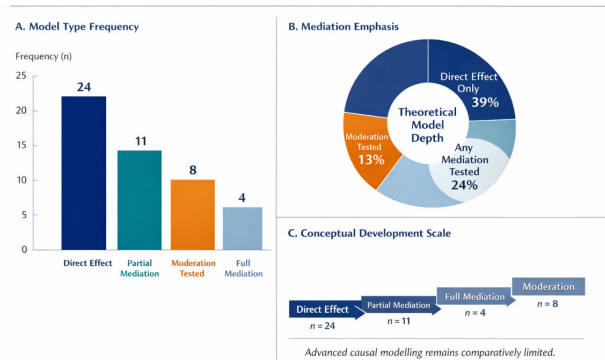


Fig. 6: Distribution of the effect models of the involved studies (N = 62): In Panel A, we report the frequency of modelling strategies, namely, direct effect models, partial mediation, full mediation and moderation analyses. The relative focus on direct and mediated modelling structures is summarised in panel B. The development of the sophistication of the theoretical modelling is seen in Panel C. Frequencies represent the frequency of the use of each analytical approach.

The figure 6 shows the type of analytical model types that were used in the included studies. Direct effect models are the most prevalent ($n = 24$) as seen in Panel A meaning that a large percentage of studies investigate the relationship between metacognitive cultural intelligence and learning outcomes without actually testing mediating effects. Partially mediated models are found in 11 studies, and full mediation models are not so common ($n = 4$). Eight studies were

applied in moderation tests indicating that there was little research that examined contextual boundary conditions. Modelling strategies are grouped together in panel B to provide a thorough theoretical insight. Surveys using mediation analysis (partial and full, $n = 15$) express a lower percentage compared to direct effect models, which means that mechanism testing is here, although not leading yet in the discipline. The conceptual ranking of modelling approaches in panel C is based on the increasing theoretical sophistication, direct associations to moderated and fully mediated model. The distribution indicates that the current trend in the research on metacognitive cultural intelligence is that of a more complex cause modelling, although it is still largely based on correlational direct-effect patterns.

Local and Contextual Diversity.

Figure 6 showed the distribution regionally. In-depth examination shows the variation of outcomes regionally. Table 7 shows contextual variation. Chinese studies focus more on academic performance. Western contexts are concerned with collaborative and communication outcomes. This can be an indication of variability of educational systems. It does not show divergence of direction. The direction of effects is still positive regionally.

Figure 7 demonstrates regional difference in the priorities of domains of learning outcomes. As we can see, in Chinese studies, the focus on academic outcomes is stronger (52%), and the focus on collaborative outcomes is relatively lower (17%), as evidenced by Panel A. Conversely, North American studies have been found to have the greatest focus on collaborative outcomes (43%), and the weakest focus on academic indicators (24%). European studies have a more equal representation in socio-emotional (34%) and collaborative (37%) areas, whereas Other East Asia settings have an average representation

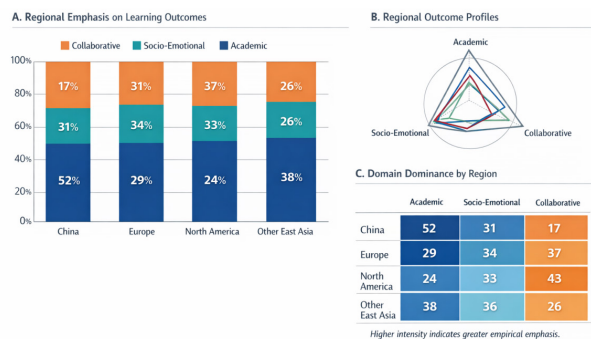


Fig.7: Local trends in learning outcome specialization: In the presentations of panel A, 100 percent stacked comparisons across regions of academic, socio-emotional, and collaborative outcome emphasis are given. RADAR profiles on panel B show the structural variation in the emphasis in domains. Panel C is a heatmap contour of intensity by region of relative domains. Percentages indicate equal stress on outcome areas in each regional sub group of studies.

in all three areas, with a bit more concentration on academic (38%) and socio-emotional (36%) results. These structural differences are visualised in panel B in the form of comparative domain profiles. The form of every regional profile underscores the change in the priorities of research as opposed to the direction of effect. On the Western background (Europe and North America), collaborative aspects are larger, and the Chinese research presents a more academically focused picture. The same pattern is also supported by panel C, which portrays the intensity gradients of domains. Increased intensity in the academic column about China is opposed to increased intensity of collaboration in North America and Europe. Socio-emotional focus is relatively constant in regions.

Structural Integrated Pathways.

In literature, one uniform pattern of regulation is seen:

Table 7: Regional Patterns in Outcome Focus

Region	Academic Focus (%)	Socio-Emotional Focus (%)	Collaborative Focus (%)
China	52	31	17
Europe	29	34	37
North America	24	33	43
Other East Asia	38	36	26

- Metacognitions planning prior to intercultural interaction.
- Observation of cultural presumptions.
- Emotion management in the context of uncertainty.
- Strategic adaptation
- Improved learning outcome

The conceptual pathway is supported by the use of this layered process:

$$\text{Learning Outcome} = B_1(\text{MCQ}) + B_2(\text{Self-Regulation}) + B_3(\text{Affective Regulation}) + \varepsilon$$

Substantial variation in the result of engagement and collaboration would be attributed to indirect pathways.

Strength and Methodological Soundness.

There was a non-significant difference in the higher quality methodological studies ($Q \geq 1.6$) in which the effect sizes (mean $B \approx .37$) were stronger in comparison with lower quality studies ($B \approx .29$). Directionality though was constant across the levels of quality. The longitudinal studies revealed stable relationships over time. Targeted training demonstrated moderate improvement of MCQ using experimental interventions.

Synthesis Summary

When put collectively, the empirical evidence demonstrates a consistent trend across settings and designs of the studies. Metacognitive cultural intelligence has been shown to have positive and consistent relations with learning outcomes that are inclusive of academic performance, engagement, adjustment, and collaborative effectiveness. Self-regulated learning is the strongest and most upheld mediator of the psychological pathways explored, meaning that MCQ primarily acts within the framework of regulatory cognitive mechanisms but not, in particular, within the framework of isolated affective mechanisms. Even though there is a clear contextual variation, especially in the relative value of academic and collaborative results in different regions, the general pattern of effects is the same. Simultaneously, the evidence base is characterized by

the concentration of methods. The prevalent ones are cross-sectional survey designs, which restrict strong causation of the survey, and the internal consistency of measurement tools is also high, but cross-cultural testing of measurement is still relatively scarce. Therefore, there is significant conceptual overlap in the field that the role of metacognitive CQ fulfills, but there is also a need to further diversify the methodology to enhance the precision and generalisability of the theories.

DISCUSSION

The purpose of this systematic review was to explain the functioning of metacognitive cultural intelligence (MCQ) as a psychological regulating process in the educational process and to determine the regular learning outcomes that have been most often related to it in both global and Chinese environments. It shows evidence of a cognitively consistent yet methodologically focused area. Positive relationships between MCQ and academic, socio-emotional, and collaborative outcomes are always observed. Nonetheless, the theoretical integration and causal testing are still lopsided.

Metacognitive CQ as a Regulatory Cognitive Process.

The most solid and most solid finding is the mediating action of self-regulated learning processes. In a range of the studies that measure mediation models, self-regulation explained the most percentage of indirect variance. This trend confirms the definition of MCQ as a more advanced regulation system, as opposed to a fixed awareness feature.

Metacognitive CQ seems to be applied in three consecutive steps. It influences anticipatory cognitive framing, first, prior to intercultural engagement. Second, it assists in following and correction in the process of interaction. Third, it enables reflective correction once the cultural mismatch has taken place. The stages are quite consistent with the existing metacognitive models within the field of educational psychology [36]. The current synthesis thus further reinforces the theory gap between the cultural intelligence theory and the self-regulated learning frameworks.

Notably, affective processes, including the reduction of intergroup anxiety was also promoted but seldom prevailing. This implies that cognitive regulation should be the main input of MCQ, and emotional stability should be the secondary effect of better cognitive interpretation. The difference is useful in developing theoretical lucidity in a subject where one is likely to be lost in both cognitive and affective levels.

Learning Outcomes: Beyond Academic Performance.

Although measurement of the most frequent outcome is academic performance, evidence base demonstrates that MCQ is even more than grade attainment. Engagement, adjustment, belonging and collaborative effectiveness are always related to greater MCQ. This wide spread of distribution points to the metacognitive CQ working on the achievement and process-oriented domains.

Collaborative outcomes were especially relevant in multicultural classes. Researches in the Western settings always associated MCQ with quality communication and less conflict.^[37] Conversely, Chinese-context research focused on the academic performance and the in-class adaptation. Such discrepancy could probably be attributed to institutionalized educational conventions and not to the non-congruent psychological processes.

The uniformity of positive directionality among regions points to the fact that MCQ is a generalisable regulatory capacity. Yet, contextual needs determine what outcomes are the most apparent. Academic indicators prevail in the examination-based systems. Collaborative indicators are more evident in learning settings based on participation.

The Chinese Environment: Intersection and Local Specificity.

In the Chinese educational setting, no effect direction reversal was found in the subgroup analysis. MCQ was still positively related to learning outcomes. Nevertheless, the emphasis on mechanisms was a little bit less. The studies that were conducted on the international students of Chinese origin more often examined anxiety reduction and adjusting processes.^[38]

This trend can be viewed in the perspective of Confucian traditions of education. The uncertain conditions in intercultural encounters may be exacerbated by the hierarchical classroom rules and high-performance expectations. Metacognitive monitoring can be used to play a stabilising role in these environments, minimising uncertainty, and facilitating academic adjustment.

Meanwhile, comparatively less emphasis on collaborative outcomes in studies in China does not suggest a lesser impact on relations [39]. Instead, it is a measure orientation. Since the internationalisation of Chinese higher education is ongoing, collaborative competencies might increasingly feature as the outcomes of research.

In total, there are indicators of modulation and not structural separation. MCQ seems to be strong and consistent in cultural systems, but the behavioural realisation is shaped to the needs of an institution.

Limitations to Causality and Methodological Appeal.

Although there is a high level of conceptual convergence, there is a low level of methodological diversity. The dominating survey designs are cross-sectional designs. There are few longitudinal and experimental studies. This has led to most evidence being correlational.

Studies of higher quality announced a bit larger effect sizes which may indicate that a rigorous methodology does not undermine observed associations [40]. Causal pathways cannot however be established without more use of intervention designs and multi-wave modelling.

Measurement invariance test is also inadequate. Considering the intercultural nature of MCQ, cross-cultural validation is more required. Invariance testing and multi-source data collection in future research should be given priority in minimizing common method variance.

Theoretical Consolidation and Conceptual Development.

The current review has a theoretical contribution in that it places the metacognitive CQ in a culturally-specific self-regulation model. Instead of defining

MCQ as a personality feature, the evidence confirms the approach of defining it as a dynamic regulation system that is activated in the context of cultural complexity.

According to the interconnected route presented in the Results section, the layered process can be the following one:

- Planning Metacognition - Control - affective regulation Strategic adaptation - learning.

This model fills the gap between cultural intelligence theory and education metacognition and social cognition models [41]. It explains the predictive ability of MCQ on performance and engagement. It further justifies the reason why regulatory process mediation is always more powerful than direct effects by themselves.

Future theoretical studies ought to improve on this stratified model and analyse mutual impacts. In one example, effective intercultural learning experiences can strengthen metacognitive monitoring abilities in the long run therefore generating developmental feedback loops.

Educational Practice Implications.

As a practical design, the research findings indicate that the metacognitive CQ cannot be developed through exposure to diversity. The development of anticipatory reflection, perspective-taking exercises, and debriefing after the interaction should be explicitly taught in terms of instructional design.

Curriculum based intercultural reflection modules can improve adjustment and performance when curriculum based in rapidly internationalising systems like those in China.^[42] Regulatory pathways may be enhanced in Western multicultural classrooms by means of collaborative simulation and feedback training. The interventions must be focused on metacognitive skills development, but not only on motivational enhancement. The key driver of desirable results seems to be regulatory capacity.

LIMITATIONS

There are a number of constraints that should be recognized. To start with, in most studies, the data relies on the self-report, therefore, common method bias may occur. Secondly, cross-sectional designs are

more common and this limits causal inference.^[43]

Third, it cannot be excluded that publication bias was involved which made positive findings more frequent than the null ones. Fourth, subgroup analysis was done to analyze Chinese contexts, but there is limited information on data in other underrepresented regions. An increase in geographic diversity would increase the generalisability.

FUTURE RESEARCH DIRECTIONS

Future studies need to transcend the present level of methodological focus and embrace designs with the capability to elucidate the developmental and causal pathways. Longitudinal modelling is also very imperative in elucidating how regulation mechanisms on metacognitive cultural intelligence will vary over time. By tracking the anticipatory planning, monitoring and adaptive revision between semesters or transitions with an academic experience, it would be possible to test whether or not metacognitive CQ is strengthened by intercultural exposure or whether it is a relatively stable regulation capacity. Experimental intervention studies are equally required. The effects of the increases in MCQ would be causally analyzed in the form of tightly structured training programmes explicitly designed to target metacognitive reflection, cultural perspective-taking, and feedback monitoring.^[44]

Further studies should also reduce measures of self-reporting through a single source. With peer rating, instructor rating, behavioural rating, and performance-based assessment, the common method bias would be minimized, and the intercultural competence in action would approach a more holistic approach. Increased cross-cultural measurement invariance testing is important too. Since the metacognitive CQ is inseparably involved in the cultural interpretation processes, the measurement equivalence should be proved in both national and institutional circumstances, and it is only in this case that the meaningful comparison may be established. Last, contextual moderators should be addressed more.^[45] Diversity density of classrooms, pedagogy instructional, norms of institutional internationalisation, and norms of power distance may be the variables that influence the intensity or

prominence of MCQ. An increase in methodological diversity on these dimensions will provide more theoretical accuracy, enhance generalisability, and enhance the policy applicability of the research findings on metacognitive cultural intelligence in education.

CONCLUSION

The systematic review was used to synthesise 62 empirical studies that elucidated the advantages of the metacognitive cultural intelligence (MCQ) in learning situations. The results show positive and consistent relations between MCQ and cognitive-academic, socio-emotional, and collaborative learning outcomes. In diverse methodological frameworks, MCQ acts as an attempt to form or more accurately as a regulatory cognitive system as opposed to a fixed awareness structure.

The strongest mediating pathway occurred in self-regulated learning. Perspective-taking and anxiety reduction also proved useful especially in culturally heterogeneous settings. Comparisons between regions found contextual diversity of outcome focus and none of directional effect difference. Chinese educational environments were more inclined to the academic adjustment whereas the western contexts were more focused on collaboration and communication. The latent regulatory framework, though, did not vary between contexts.

Discipline has conceptual but methodological focus. Cross-sectional survey designs are predominant and longitudinal evidence and experimental evidence is limited. The reliability of measurements is good, but the cross-cultural invariance tests should be extended.

Its results suggest that an implicated model is a layered model where metacognition CQ improves anticipatory framing, monitoring, emotional regulation and strategic adaption resulting in enhanced learning outcomes. This paradigm supports the relationship between the cultural intelligence theory and the educational metacognition research.

Regulatory cognitive capacity can be one of the key educational competencies, as global classrooms are becoming more and more intercultural. Further development of this area will also need more robust

causal designs, a wide geographic coverage and theoretically based intervention studies.

Author Contributions

Conceptualization, X.X.; methodology, X.X.; formal analysis, X.X.; investigation, X.X.; data curation, X.X.; writing—original draft preparation, X.X.; writing—review and editing, X.X.; visualization, X.X.; supervision, X.X. All authors have read and agreed to the published version of the manuscript.

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Conflict of Interest

The authors assert that they are not in conflict of interest.

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