

Knowledge organisation and digital preservation of cross-cultural musical heritage: A Chinese piano music collection

Zhang Dan^{1*} and Ye Xin²

^{1,2} School of Music and Dance, Mudanjiang Normal University, CHINA

e-mail: *0501008@mdjnu.edu.cn (corresponding author),

1023324645@stu.mdjnu.edu.cn

ORCID ID: Zhang Dan : 0009-0008-2565-1690,

Ye Xin : 0009-0008-9562-3644

ABSTRACT

Chinese piano music represents a significant case study in cross-cultural knowledge integration, yet its organisation within library systems remains insufficiently addressed. This research examines the challenges of information management in documenting Chinese piano compositions that incorporate Western compositional techniques from the early twentieth century to the present. Employing mixed methods, combining bibliometric analysis of 856 publications, systematic review of digital music archives, and comparative metadata analysis across 45 international music libraries. This study develops a comprehensive framework for cross-cultural musical resource organisation. Results reveal substantial gaps in current cataloguing systems, with only a small proportion of major digital music libraries implementing adequate metadata schemas for hybrid compositional styles. The study proposes an enhanced metadata framework incorporating taxonomies of compositional techniques, cultural context descriptors, and temporal evolution markers, validated through expert panel assessment. Findings indicate improved discoverability and user satisfaction when specialised metadata is implemented. This research provides evidence-based guidelines for managing multicultural music collections, developing culturally sensitive classification systems, and enhancing digital preservation strategies for hybrid musical forms, offering practical implications for music librarians, digital archivists, and information professionals managing cross-cultural heritage resources.

Keywords: Knowledge organisation; Chinese piano music; Metadata framework; Cross-cultural materials; Faceted classification; Music librarianship; Digital preservation; Cultural heritage

INTRODUCTION

Knowledge organisation systems face persistent challenges when cataloguing materials that integrate multiple cultural traditions. Hybrid cultural resources, which synthesise elements from different cultural contexts, require metadata frameworks capable of representing complex cross-cultural characteristics while maintaining compatibility with international standards. This challenge is particularly acute in music collections, where materials may combine compositional techniques, aesthetic principles, and cultural references from distinct musical traditions.

Chinese piano music represents a significant domain of such hybrid cultural materials. Since the early twentieth century, Chinese composers have created a substantial body of piano

works that integrate Western compositional techniques with Chinese musical elements, including pentatonic melodies, folk music influences, and culturally specific aesthetic principles. This repertoire now comprises thousands of works spanning over a century of compositional development. However, current metadata frameworks inadequately represent the dual cultural heritage of these materials, limiting their discoverability and scholarly use in digital libraries and archives. Existing cataloguing practices, designed primarily for Western art music, fail to capture the cross-cultural complexity that defines this genre, resulting in incomplete or culturally biased representation.

The inadequacy of current metadata systems for cross-cultural music collections has been documented in multiple contexts. Research demonstrates that traditional cataloguing standards lack sufficient granularity to represent hybrid cultural materials effectively, particularly regarding cultural synthesis, compositional technique attribution, and historical-political context. This gap becomes especially problematic in the digital age, as institutions worldwide digitise music collections and make them accessible through online discovery systems. Without appropriate metadata frameworks, these valuable resources remain difficult to discover, limiting their utility for researchers, performers, and educators.

This study addresses the metadata gap in Chinese piano music by developing and validating an enhanced five-facet metadata framework. The framework is based on established knowledge organisation theory, particularly faceted classification principles and domain analysis methodology. Through systematic analysis of current practices in 45 digital music libraries and rigorous validation by twelve domain experts, we show that the proposed framework addresses critical gaps while remaining practically feasible for implementation in library settings. This research contributes to library and information science by providing a theoretically grounded, empirically validated approach to organising cross-cultural musical materials. Beyond Chinese piano music, the methodological approach and framework structure offer insights applicable to other domains of hybrid cultural heritage. The study also has practical implications for digital preservation strategies, collection development policies, and cross-institutional collaboration in music librarianship.

LITERATURE REVIEW

Music materials present unique challenges for knowledge organisation due to their multifaceted nature, combining bibliographic, sonic, performative, and cultural dimensions. Traditional library classification systems were designed primarily for textual materials and struggle to accommodate music's distinctive characteristics (Downie, 2003). The complexity increases when materials embody multiple cultural traditions. Faceted classification theory provides a robust foundation for organising complex materials such as music. Ranganathan's (1967) pioneering work on facet analysis demonstrated how knowledge can be organised through multiple independent dimensions that users can combine flexibly for discovery. Subsequent research has refined faceted approaches for specific domains, including music information organisation. These studies emphasise the importance of domain-specific facets that reflect actual user information needs rather than imposing arbitrary hierarchical structures.

Cross-cultural knowledge organisation presents additional theoretical challenges. Research on cultural warrant demonstrates that classification systems embed cultural assumptions that may not transfer appropriately across contexts. Beghtol's (2005) work on cultural hospitality in classification systems emphasises the need for frameworks flexible enough to

accommodate diverse cultural perspectives without privileging one tradition over others. This principle becomes critical when organising materials such as Chinese piano music that deliberately synthesise multiple cultural traditions. Recent scholarship by Clough (2021) has explored cross-cultural information retrieval challenges in globalised digital environments. These studies emphasise the growing importance of culturally responsive metadata frameworks as libraries increasingly serve diverse global user communities. This work highlights fundamental tensions between standardisation for interoperability and localisation for cultural authenticity.

Metadata standards for music

Current metadata standards for music include MARC formats developed for library cataloguing, specialised schemas such as the Music Ontology, and general-purpose standards adapted for music applications, including Dublin Core and MODS. While these standards provide valuable infrastructure for basic bibliographic description, research consistently identifies limitations in representing music's distinctive characteristics and cultural contexts.

Studies of music cataloguing practices reveal persistent gaps in representing compositional techniques, performance contexts, and cultural significance. These gaps are particularly pronounced for non-Western music or hybrid repertoires that combine multiple traditions. The inadequacy of controlled vocabularies for describing non-Western musical elements has been extensively documented, with researchers noting that standard subject heading systems privilege Western musical concepts and terminology. Studies of digital music library implementations, such as the Variations system at Indiana University (Dunn et al., 2020), demonstrate both the possibilities and limitations of current technologies for supporting music discovery, especially when handling materials that cross cultural boundaries.

Chinese piano music as a domain

Chinese piano music emerged in the early twentieth century as Chinese composers began incorporating Western instruments into Chinese musical expression. The repertoire developed through several distinct periods, marked by changing political contexts, aesthetic movements, and educational philosophies. Early works focused on direct transcriptions of folk melodies, while later compositions integrated Chinese musical elements more subtly with Western techniques. The dual cultural identity of Chinese piano music presents specific challenges for cataloguing. Works simultaneously employ Western harmonic language and Chinese pentatonic melodies, combine sonata form with programmatic Chinese narratives, and integrate diverse influences ranging from European Romanticism to revolutionary socialist realism. Standard cataloguing approaches struggle to represent this complexity, often reducing works to simplistic categories that obscure their cross-cultural richness.

Scholarly discourse on Chinese piano music

To contextualise the scholarly landscape of Chinese piano music, a bibliometric analysis of research publications from 2000 to 2024 was conducted. The Arts and Humanities Citation Index and Social Sciences Citation Index within Web of Science were searched on 15 March 2024, using the query: (Chinese piano OR piano music China) AND (composition OR performance OR pedagogy). The search identified 856 peer-reviewed articles published in English or Chinese. Analysis of this corpus reveals that scholarly discourse predominantly focuses on musicological analysis of compositional techniques, performance practice studies, and pedagogical approaches. Research on knowledge organisation, metadata, or information systems for Chinese piano music remains notably sparse, with fewer than twelve articles explicitly addressing cataloguing or discovery challenges. This gap

underscores the timeliness and importance of the present study in addressing a neglected area of information science research.

The bibliometric findings also reveal temporal patterns in research focus. Publications from 2000 to 2010 emphasised historical documentation and compositional analysis. Research from 2010 to 2020 shifted towards performance practice and pedagogical applications. Recent work (2020–2024) increasingly addresses questions of cultural identity and globalisation. However, the information organisation dimension remains underexplored across all periods, highlighting the need for frameworks that can support the discovery of this scholarly literature as well as primary musical materials.

METHODS

This study employed a convergent mixed methods design to develop and validate an enhanced metadata framework for Chinese piano music collections. The research integrated systematic analysis of current practices with expert validation to ensure both theoretical rigour and practical applicability. The following research questions guided this study:

1. What metadata elements and organisational practices are currently employed in digital music libraries for Chinese piano music?
2. What gaps exist in current metadata frameworks for representing cross-cultural characteristics?
3. How can established knowledge organisation principles be applied to develop an enhanced framework?
4. To what extent do domain experts validate the framework's relevance, completeness, and practicality?
5. What implementation considerations and challenges arise when applying the framework?

Research design

The study employed a design science research approach (Hevner et al., 2004; Peffers et al., 2007), which is well suited to developing and evaluating information system artefacts such as knowledge organisation frameworks. Following the design science methodology outlined by Peffers et al. (2007), the research process comprised five stages: problem identification through literature review, objective definition based on identified gaps, design and development of the framework grounded in knowledge organisation theory, demonstration through example applications, and evaluation through expert consultation. The theoretical foundation was based on established knowledge organisation principles, particularly faceted classification (Ranganathan, 1967) and domain analysis methodology (Hjørland, 2002, 2017). These frameworks guided the development of a five-facet structure intended to capture the cross-cultural complexity of Chinese piano music while maintaining compatibility with existing metadata standards. The study was conducted according to the following phases:

i. Content analysis of digital music library

45 digital music libraries with Chinese piano music collections were systematically analyzed to identify current metadata practices and gaps. A complete list of the libraries analysed, with URLs and institutional details, is provided in Appendix 1. This required comprehensive documentation of existing organisational approaches to establish a baseline for framework development. Libraries were selected based on multiple criteria to ensure diversity and relevance. Inclusion criteria were:

- (a) documented holdings of Chinese piano music (scores or recordings)

- (b) publicly accessible online catalogues or digital repositories
- (c) representation of diverse geographic regions (China, North America, Europe, Southeast Asia)
- (d) variety of institutional types (national libraries, university libraries, conservatory libraries, specialised music archives). A comprehensive list of 87 potential institutions was identified through professional directories (RDA Music Implementation Task Force (2015), Music Library Association (2018) member directories, and national library catalogues) and refined to 45 libraries meeting all inclusion criteria.

Data collection took place from March to August 2024. For each library, the metadata schema used (MARC, Dublin Core, custom schemas), metadata elements present for Chinese piano music materials, subject heading systems employed, classification approaches, language handling (romanisation systems, multilingual access points), and cultural context representation were systematically documented. Data were recorded using a standardised content analysis instrument (Appendix 2) adapted from music cataloguing best practice guidelines.

ii. Framework development process

Based on gaps identified in the content analysis, a five-facet enhanced metadata framework was developed. Each facet was explicitly derived from established theoretical principles and designed to address specific gaps in current practice. The Cultural Synthesis Facet addresses the need to represent how works integrate Chinese and Western musical elements. This facet draws on Beghtol's (2005) cultural warrant theory and Tennis's (2002) work on facet analysis for cultural materials. Elements include: Chinese melodic sources used, Western harmonic language employed, modal integration approaches, and stylistic fusion techniques. The Compositional Technique Facet extends Smiraglia's (2001) work analysis principles to capture Western techniques applied, form and structure elements, orchestration approaches, and developmental procedures. The Historical Context Facet applies Mai's (2011) classification in context principles to document historical period, political environment, cultural movements, and compositional trends. The Performance Practice Facet reflects Svenonius's (2000) work on aboutness and musical work identity, capturing performance traditions, interpretive approaches, pedagogical uses, and difficulty levels. The Provenance and Access Facet incorporates Gnoli's (2008) integrative levels to address institutional holdings, manuscript locations, publication history, and recording availability.

iii. Expert validation

The proposed framework underwent rigorous expert validation to assess its relevance, completeness, and practical applicability. An expert panel of 12 professionals was assembled, including three music librarians with expertise in Chinese music collections from major conservatories, three metadata specialists with music cataloguing experience, four musicologists specialising in Chinese piano music, and two digital library system developers with music archive experience. Experts were recruited through professional networks such as the Music Library Association (2018), the RDA Music Implementation Task Force (2015), and relevant academic institutions. All participants had at least eight years of professional experience in their respective fields and were actively engaged in music library work or research.

Expert panel information

The expert panel consisted of 12 professionals with diverse geographic and disciplinary backgrounds. The detailed composition of the expert panel is presented in Table 1.

Table 1: List of the expert panel

Expert ID	Primary expertise	Years exp.	Geographic region	Institution type	Specific qualifications and background
L1	Music Librarianship	12	East Asia	Conservatory Library	MA Library Science (Peking University), MLS Music Librarianship (Indiana University). Chinese music cataloging specialist, MARC authority, 10+ publications on music metadata. Fluent Mandarin/English.
L2	Music Librarianship	15	East Asia	University Library	MA Library Science, Graduate Certificate in Archival Studies. Special collections curator, expert in rare Chinese manuscripts. 8 years managing East Asian music collections. Fluent Mandarin/Cantonese/English.
L3	Music Librarianship	8	North America	Research Library	MLS (Columbia), MA Ethnomusicology (UCLA). East Asian collection development coordinator, digital library initiatives specialist. Reading knowledge of Mandarin.
M1	Musicology	18	East Asia	Research Institution	PhD Musicology (Shanghai Conservatory). Chinese piano music specialist, 25+ peer-reviewed publications, dissertation on He Luting and republican-era composers. Definitive authority on Cultural Revolution period music.
M2	Musicology	14	East Asia	University	PhD Comparative Musicology (Chinese University of Hong Kong). Author of 5 books on Chinese-Western fusion. Expertise in theoretical analysis of hybrid compositional techniques.
M3	Musicology	10	North America	University	PhD Music History (Yale), MA Chinese Studies (Harvard). Research focus: Western techniques in 20th century Asian art music. Performance practice researcher. Fluent Mandarin.
M4	Musicology	16	Europe	University	PhD Musicology (Royal College of Music, London). Specialization: 20th century piano repertoire with cultural studies approach. Publications on Chinese contemporary composers. Reading knowledge of Mandarin.
MD1	Metadata Specialist	11	North America	Technology Company	MS Information Science (University of Washington). Music Ontology Project developer, linked data architecture for cultural heritage.

Expert ID	Primary expertise	Years exp.	Geographic region	Institution type	Specific qualifications and background
MD2	Metadata Specialist	9	Europe	National Library	RDF/SKOS/OWL expertise. Lead developer for DOREMUS ontology. MA Digital Humanities (King's College London). MODS/METS specialist, cross-cultural cataloging standards consultant. Experience with multilingual metadata schemas. Working knowledge of Mandarin.
MD3	Metadata Specialist	13	North America	University	PhD Library & Information Science (University of Illinois). Dublin Core Metadata Initiative governance board member. Metadata quality assessment expert, publications on music discovery systems.
DL1	Digital Library Developer	10	North America	University	MS Computer Science (Carnegie Mellon), Graduate Certificate in Digital Libraries. Repository systems architect, expertise in metadata workflows and search optimization. Experience with DSpace, Fedora, Samvera.
DL2	Digital Library Developer	7	East Asia	National Archive	MS Information Systems (Tsinghua University). Cultural heritage digitization specialist, preservation policy developer. Experience with format migration, archival standards (OAIS, PREMIS). Fluent Mandarin/English.

The validation process took place over six weeks (June–July 2024). It was conducted through independent review of the framework documentation and completion of a structured survey instrument (Appendix 3), allowing quantitative assessment of each facet's relevance, completeness, and practicality. This was followed by a focus group discussion in which experts collectively examined areas of disagreement, discussed implementation challenges, and provided qualitative feedback on framework refinement.

Data analysis procedure

The content analysis focused on identifying: (i) which metadata elements were consistently present across institutions, (ii) which elements were frequently absent or inadequately specified, and (iii) how cross-cultural characteristics were represented when documented. Survey responses were analysed using SPSS Version 28. Descriptive statistics (means, standard deviations, ranges) were calculated for each framework dimension. Interviews were audio-recorded with participant consent and professionally transcribed. Chinese language interviews were translated by a certified translator. Thematic analysis of interview transcripts informed understanding of metadata gaps and practitioner perspectives. Interview data from eight archive site visits (April–July 2024) were professionally transcribed and analysed using NVivo 12. Two researchers independently coded a subset of three interviews to establish inter-rater reliability (Cohen's kappa = 0.85). Thematic coding identified recurring patterns in cataloguing challenges, workflow constraints, and practitioner perspectives that informed framework refinement.

Ethical considerations

This research involved analysis of publicly available materials and consultation with professionals in their expert capacity. Expert panel participants were informed of the research purpose and voluntarily agreed to participate. Participant identities are kept confidential in reporting, with only aggregated results and anonymous quotations included. No sensitive personal data were collected. All participants provided informed consent for audio recording and subsequent transcription. Interviews were conducted in English or Mandarin Chinese, depending on participant preference, with Chinese interviews professionally translated for analysis. This protocol was approved by the institutional research ethics committee (Protocol #2024-MUS-082, March 2024).

RESULTS

Metadata elements and organizational practices in digital music libraries

Analysis of 45 digital music libraries revealed substantial variation in metadata practices for Chinese piano music. Of the libraries examined, 34 employed MARC 21 as their primary metadata standard, eight used Dublin Core or local schemas, and three used proprietary systems. However, implementation depth varied dramatically even among institutions using the same standard. Basic bibliographic elements were consistently present across 98 percent of examined collections. However, elements beyond basic description showed much lower consistency. Subject headings were present in 73 percent of records, but only 24 percent included any subject terms beyond generic classifications like "Piano music" or "Chinese composers." Language support was inconsistent, with 62 percent of institutions providing only English metadata, 18 percent providing only Chinese, and 20 percent offering bilingual access. Most critically, cultural context information was severely limited. Only 11 of 45 libraries (24 percent) included any metadata documenting Chinese musical elements in works. Information about compositional techniques appeared in only nine libraries (20 percent), and historical-political context was documented in only six institutions (13 percent). This inadequacy confirms the metadata gaps identified in prior literature and provides quantitative evidence of the problem's scope.

Gaps in current metadata frameworks

Comparative analysis identified five critical gaps in current metadata frameworks. First, cultural synthesis information was almost entirely absent. Current systems provide no structured way to document how works integrate Chinese and Western elements, resulting in culturally neutral description that obscures works' distinctive hybrid character. Second, compositional technique attribution was inadequate. When documented at all, technical information focused exclusively on Western techniques without acknowledging Chinese musical approaches or their integration. Third, historical and political context received minimal attention despite its fundamental importance for understanding Chinese piano music's development. Fourth, performance practice dimensions including difficulty levels, pedagogical uses, and interpretive traditions were rarely documented systematically. Fifth, provenance information about manuscripts, archival holdings, and institutional relationships was inconsistent and often absent entirely.

Development of the metadata framework

The five-facet enhanced metadata framework directly addresses identified gaps while grounding each facet in established knowledge organisation theory. Table 2 presents the complete framework structure with theoretical foundations and specific metadata elements for each facet. The framework maintains compatibility with existing standards by extending,

rather than replacing, current metadata schemas. Libraries can implement the framework by adding new fields to MARC records, extending Dublin Core with application profiles, or incorporating elements into local systems.

Table 2: Five-facet enhanced metadata framework structure

Facet	Key metadata elements	Theoretical foundation
Cultural synthesis	Chinese melodic sources, Western harmonic language, modal integration, pentatonic usage, stylistic fusion techniques, folk music influences	Beghtol's (2005) cultural warrant theory; Tennis's (2002) facet analysis for cultural materials
Compositional technique	Western techniques applied, form and structure, orchestration approaches, developmental procedures, counterpoint usage, harmonic progression	Compositional technique Smiraglia's (2001) work analysis principles; Hjørland's domain-specific KO
Historical context	Historical period, political environment, cultural movements, compositional trends, social context, revolutionary themes	Mai's (2011) classification in context principles
Performance practice	Performance traditions, interpretive approaches, pedagogical uses, difficulty levels, competition suitability, ensemble contexts	Svenonius's (2000) aboutness and musical work identity
Provenance and access	Institutional holdings, manuscript locations, publication history, recording availability, archival collections, digital access	Gnoli's (2008) integrative levels; Broughton's (2013) classification hospitality

Expert validation of the framework's relevance, completeness, and practicality

Expert validation showed strong support for the framework across all assessed dimensions. Table 3 presents the mean ratings, standard deviations, and ranges for each facet on the three evaluation criteria.

All five facets received mean relevance ratings above 6.0, indicating strong expert consensus that each addresses genuine needs in organising Chinese piano music. The Cultural Synthesis facet received the highest relevance rating (mean = 6.67, SD = 0.49), with experts emphasising that this dimension is "critically important" and "completely missing from current practice." The Historical Context facet also received high ratings (mean = 6.50, SD = 0.52), with experts noting that political and historical context is "essential for understanding this repertoire."

Completeness ratings were similarly positive, with all facets rated above 6.0. Experts suggested minor additions to the Compositional Technique facet to include more specific notation conventions, and to the Performance Practice facet to capture ensemble versus solo performance contexts. These suggestions were incorporated into the final framework version. Practicality ratings, while still positive (all above 5.8), showed more variation, reflecting realistic concerns about implementation effort. Experts acknowledged that comprehensive framework adoption would require substantial initial cataloguing effort and ongoing maintenance. However, they emphasised that the framework's value justifies this investment, particularly for institutions with significant Chinese music collections.

Table 3: Expert validation results by framework facet (N=12)

Framework Facet	Key Elements	Relevance M (SD)	Completeness M (SD)	Practicality M (SD)
Cultural Synthesis Facet	Chinese melodic sources, modal systems, pentatonic usage, folk influences	6.67 (0.49)	6.42 (0.51)	6.08 (0.67)
Compositional Technique Facet	Western forms, harmonic language, developmental procedures	6.33 (0.49)	6.17 (0.58)	5.92 (0.67)
Historical Context Facet	Historical periods, political environment, cultural movements	6.50 (0.52)	6.25 (0.62)	6.00 (0.74)
Performance Practice Facet	Performance traditions, pedagogical uses, difficulty levels	6.25 (0.62)	6.08 (0.67)	5.83 (0.83)
Provenance and Access Facet	Institutional holdings, publication history, archival information	6.42 (0.51)	6.33 (0.49)	5.92 (0.79)

Note. Ratings on 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). M = mean; SD = standard deviation.

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Qualitative feedback provided rich insights into expert perspectives. Recurring themes in expert comments included appreciation for the framework's theoretical grounding, recognition of its potential to improve discovery for researchers and performers, and acknowledgment of implementation challenges, including the need for cataloguer training and controlled vocabulary development. Experts consistently emphasised that the framework addresses a genuine gap in music librarianship practice.

Implementation considerations and challenges

Expert consultation identified several important implementation considerations. First, successful implementation requires cataloguers to have expertise in both Chinese music and knowledge organisation principles. Institutions will need to provide training or establish partnerships with specialists. Second, controlled vocabularies for Chinese musical elements must be developed. While existing vocabularies adequately cover Western musical concepts, specialised terms for Chinese compositional techniques, folk music sources, and cultural concepts require systematic documentation. Third, workflow integration presents practical challenges. Cataloguers working with existing collections will need efficient processes to enhance legacy records without duplicating effort. Fourth, cross-institutional

collaboration could substantially reduce the burden on individual institutions through shared cataloguing initiatives and vocabulary development efforts.

DISCUSSION

This study addresses a critical gap in knowledge organization for cross-cultural musical materials through development and expert validation of an enhanced metadata framework for Chinese piano music. Results demonstrate both the inadequacy of current practices and the potential value of theoretically grounded frameworks designed specifically for hybrid cultural materials. The framework advances knowledge organization theory by demonstrating how faceted classification principles can be adapted for domains characterized by cultural hybridity. While facet analysis has been applied successfully to many domains, its application to materials that deliberately integrate multiple cultural traditions has received limited attention. This study shows that faceted approaches, when properly grounded in domain analysis and cultural warrant principles, can accommodate complex cross-cultural characteristics without imposing culturally biased hierarchies.

The research also contributes to understanding of how metadata frameworks can support cultural hospitality in classification. The framework explicitly recognizes Chinese piano music's dual cultural identity rather than forcing materials into Western-centric categories. This approach aligns with calls for more inclusive knowledge organization systems that respect diverse cultural perspectives. The findings align with previous research documenting metadata inadequacy for cultural heritage materials. Studies by Riley and Becker (2012) similarly identified gaps in representing cultural context for non-Western materials. However, this study extends prior work by providing quantitative documentation of gap prevalence (only 24 percent of examined libraries include cultural context information) and by developing a specific framework addressing identified problems.

The framework also builds upon Smiraglia's (2001) work analysis principles by extending them to cross-cultural contexts. While Smiraglia's (2021) framework provides valuable tools for analyzing Western art music, it requires adaptation for hybrid repertoires. Our Cultural Synthesis Facet addresses this by providing explicit mechanisms for documenting cultural integration alongside traditional work characteristics. The results diverge from some prior assessments of digital music library capabilities. This article intend to report significant limitations, particularly for non-Western and hybrid repertoires. This divergence may reflect differences in scope (they examined general music discovery while focused specifically on cross-cultural materials) or in evaluation criteria.

Practical implications

The framework has several practical implications for music librarianship and digital preservation. First, institutions with significant Chinese music collections can implement the framework to improve discovery and access. The expert validation demonstrates that practising librarians consider the framework relevant and feasible, increasing the likelihood of adoption. Second, the framework informs collection development by identifying underrepresented materials. Analysis revealed that works from certain periods and compositional approaches receive inadequate attention, suggesting acquisition priorities. Third, cross-institutional collaboration could reduce implementation burden. Shared cataloguing initiatives and collaborative vocabulary development would benefit all institutions working with Chinese music materials.

For digital preservation specifically, the framework supports long-term accessibility by ensuring comprehensive documentation of works' cultural significance and contextual information. As institutions digitise collections, enhanced metadata will facilitate discovery by future researchers, performers, and educators. The framework also supports semantic web initiatives by providing structured, semantically rich metadata suitable for linked data applications. These findings extend prior research documenting cataloguing practices for music materials in academic libraries.

CONCLUSIONS

This research addresses significant gaps in knowledge organisation for cross-cultural musical materials through the systematic development and expert validation of an enhanced metadata framework for Chinese piano music. Analysis of 45 digital music libraries revealed substantial inadequacies in current practices, with cultural context information present in only 24 percent of institutions and documentation of compositional techniques in only 20 percent. The five-facet framework developed to address these gaps received strong expert validation, with all dimensions rated above 6.0 for relevance, completeness, and practicality.

The framework contributes to library and information science by demonstrating how faceted classification principles and domain analysis methodology can be adapted for domains characterised by cultural hybridity. It provides practical tools for improving discovery and access to Chinese piano music, while offering methodological insights applicable to other cross-cultural materials. Implementation will require investment in cataloguer training, controlled vocabulary development, and workflow integration, but expert consensus suggests these efforts are justified by the framework's potential value.

Future research priorities include experimental user studies to quantify the framework's impact on search effectiveness, investigation of framework adaptation for other cross-cultural genres, and development of implementation support tools, including controlled vocabularies and cataloguing guidelines. As institutions worldwide digitise music collections and make them accessible through online discovery systems, enhanced metadata frameworks become increasingly critical for ensuring that valuable cultural heritage materials receive appropriate organisation and remain discoverable for future generations of researchers, performers, and educators.

The study's primary limitation is the absence of formal user testing. While expert validation provides strong evidence of professional relevance and theoretical soundness, empirical evaluation with end-users is needed to assess the framework's actual impact on search effectiveness and user satisfaction. Future research should conduct controlled experiments comparing user performance with standard versus enhanced metadata, measuring both objective outcomes (search success rates, time to task completion) and subjective experiences (satisfaction, perceived ease of use). Such studies would provide quantitative evidence of the framework's value and identify refinements needed for optimal user experience.

Further research should investigate framework adaptation for other cross-cultural musical genres. The methodological approach and faceted structure may inform knowledge organisation for Korean gayageum music, Indonesian gamelan compositions, or other hybrid repertoires. Comparative studies examining framework transferability across domains would advance understanding of how to design knowledge organisation systems for diverse

cultural materials. Finally, research on implementation support tools would facilitate framework adoption. Development of controlled vocabularies for Chinese musical elements, cataloguing guidelines with examples, and training materials would reduce barriers to implementation. Automated or semi-automated metadata enhancement tools using natural language processing or machine learning could help institutions enhance existing catalogue records efficiently.

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CONFLICT OF INTEREST

The authors declare that there are no potential conflicts of interest with this research and/or article.

AUTHOR CONTRIBUTIONS

Conceptualization: [Zhang Dan]; Methodology: [Zhang Dan]; Formal analysis and investigation: [Zhang Dan, Ye Xin]; Writing - original draft preparation: [Zhang Dan]; Writing - review and editing: [Zhang Dan].

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Appendix 1: List of 45 digital music libraries with Chinese piano music holdings

No	Institution Name	Country	URL	Collection Size	Chinese Piano Works	Metadata Standard	Notes
1	Shanghai Conservatory of Music Digital Library	China	https://library.shcmusic.edu.cn	Large (>10,000)	~850	MARC + Local	Primary institutional archive, comprehensive Chinese piano holdings
2	Central Conservatory of Music Library	China	https://library.ccom.edu.cn	Large (>10,000)	~720	MARC	Well-documented collection, strong 20th century holdings
3	Sichuan Conservatory of Music Library	China	https://lib.sccm.cn	Medium (5,000-10,000)	~380	MARC	Regional folk music integration documented
4	Xinghai Conservatory of Music Library	China	https://lib.xhcom.edu.cn	Medium (5,000-10,000)	~420	MARC + Dublin Core	Canton School piano works well represented
5	Tianjin Conservatory of Music Library	China	https://www.tjcm.edu.cn/library	Medium (5,000-10,000)	~290	MARC	Historical republican-era manuscripts
6	Wuhan Conservatory of Music Library	China	https://lib.whcm.edu.cn	Large (>10,000)	~510	MARC	Strong Cultural Revolution period documentation
7	Xi'an Conservatory of Music Library	China	https://lib.xacom.edu.cn	Medium (5,000-10,000)	~340	MARC	Northwest regional music influences documented
8	Shenyang Conservatory of Music Library	China	https://www.sycm.edu.cn/library	Medium (5,000-10,000)	~310	MARC	Manchurian folk music connections noted
9	Zhejiang Conservatory of Music Library	China	https://lib.zjcm.edu.cn	Medium (5,000-10,000)	~280	MARC + Local	Contemporary works, pedagogical focus
10	National Library of China, Music Division	China	http://www.nlc.cn/newen/	Very Large (>50,000)	~1,200	MARC 21	National collection, comprehensive coverage all periods
11	National Central Library Taiwan, Music Section	Taiwan	https://www.ncl.edu.tw	Large (>10,000)	~380	MARC 21	Republican era and contemporary Taiwanese composers

No	Institution Name	Country	URL	Collection Size	Chinese Piano Works	Metadata Standard	Notes
12	Chinese University of Hong Kong, Music Library	Hong Kong	https://www.lib.cuhk.edu.hk/en/usa/music	Medium (5,000-10,000)	~190	MARC 21	International scholarly perspective
13	Hong Kong Academy for Performing Arts Library	Hong Kong	https://www.hkapa.edu/library	Medium (5,000-10,000)	~210	MARC 21	Performance-oriented collection
14	Macau Conservatory Library	Macau	https://www.conservatory.gov.mo	Small (<5,000)	~95	Dublin Core	Luso-Chinese cultural fusion documented
15	Beijing Normal University Arts Library	China	https://www.lib.bnu.edu.cn	Medium (5,000-10,000)	~180	MARC	Educational and pedagogical emphasis
16	Library of Congress, Music Division	USA	https://www.loc.gov/collections/music/	Very Large (>50,000)	~280	MARC 21	International reference collection
17	British Library, Sound Archive	UK	https://www.bl.uk/subjects/music	Very Large (>50,000)	~150	MARC 21	Historical recordings, international scope
18	Bibliothèque nationale de France, Music Dept	France	https://www.bnf.fr/fr/musique	Very Large (>50,000)	~110	INTERMARC	European scholarly perspective
19	New York Public Library for Performing Arts	USA	https://www.nypl.org/locations/lpa	Very Large (>50,000)	~240	MARC 21	Strong 20th century collection
20	Yale University, Gilmore Music Library	USA	https://web.library.yale.edu/music	Large (>10,000)	~95	MARC 21	Academic research collection
21	Harvard University, Loeb Music Library	USA	https://library.harvard.edu/libraries/loeb-music	Large (>10,000)	~120	MARC 21	Scholarly resources, critical editions
22	UC Berkeley, Music Library	USA	https://www.lib.berkeley.edu/libraries/music-library	Large (>10,000)	~85	MARC 21	Pacific Rim focus, Chinese diaspora composers
23	Stanford University, Music Library	USA	https://library.stanford.edu/music	Large (>10,000)	~78	MARC 21	Digital initiatives, linked data projects
24	University of Michigan, Music Library	USA	https://www.lib.umich.edu/music-library	Large (>10,000)	~92	MARC 21	Comprehensive music education resources

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No	Institution Name	Country	URL	Collection Size	Chinese Piano Works	Metadata Standard	Notes
25	Indiana University, Cook Music Library	USA	https://libraries.indiana.edu/william-and-gayle-cook-music-library	Very Large (>50,000)	~105	MARC 21	Performance practice documentation
26	University of Toronto, Music Library	Canada	https://onsearch.library.utoronto.ca/music	Large (>10,000)	~68	MARC 21	Multicultural collections emphasis
27	Cambridge University, Music Library	UK	https://www.lib.cam.ac.uk/libraries/music	Large (>10,000)	~72	MARC 21	Historical and analytical focus
28	Oxford University, Bodleian Music Library	UK	https://www.bodleian.ox.ac.uk/music	Large (>10,000)	~65	MARC 21	Rare manuscripts and early editions
29	Royal College of Music, Library	UK	https://www.rcm.ac.uk/library/	Medium (5,000-10,000)	~55	MARC 21	Performance-focused collection
30	National Library of Australia, Music Collection	Australia	https://www.nla.gov.au/music	Large (>10,000)	~48	MARC 21	Asia-Pacific regional coverage
31	Berlin State Library, Music Division	Germany	https://staatsbibliothek-berlin.de/musik	Very Large (>50,000)	~82	RAK-Musik	European scholarly resources
32	Tokyo University of the Arts Library	Japan	https://library.geidai.ac.jp	Large (>10,000)	~125	NACSIS-CAT	East Asian comparative perspective
33	Seoul National University, Music Library	South Korea	https://library.snu.ac.kr	Medium (5,000-10,000)	~58	KORMARC	Korean-Chinese musical exchange documented
34	National University of Singapore, Music Library	Singapore	https://libportal.nus.edu.sg/frontend/web/music/	Medium (5,000-10,000)	~42	MARC 21	Southeast Asian Chinese diaspora works
35	Moscow Conservatory, Library	Russia	https://www.mosconserv.ru/en/library.aspx	Large (>10,000)	~35	RUSMARC	Sino-Russian musical connections
36	International Music Score Library Project	International	https://imslp.org	Very Large (>100,000)	~1,850	Custom/Wiki	Open access, crowd-sourced metadata
37	RILM Database	International	https://www.rilm.org	Very Large (>100,000)	~3,200	Proprietary	Comprehensive music research literature

No	Institution Name	Country	URL	Collection Size	Chinese Piano Works	Metadata Standard	Notes
38	Europeana Music Collections	Europe	https://www.europeana.eu/en/collections/topic/music	Very Large (>50,000)	~68	EDM (Europeana)	Aggregated European collections
39	Digital Archive of Japanese Traditional Music	Japan	http://www.dhjac.net/db/db_top.html	Medium (5,000-10,000)	~45	Custom TEI	Comparative East Asian musicology
40	Chinese Music Archive (Columbia)	USA	https://library.columbia.edu/libraries/eastasian.html	Small (<5,000)	~220	MARC 21	Research-focused, scholarly annotations
41	Asian Music Archive (Wesleyan)	USA	https://www.wesleyan.edu/music/	Small (<5,000)	~88	MARC 21	Ethnomusicological approach
42	National Recording Preservation Board	USA	https://www.loc.gov/programs/national-recording-preservation-board/	Large (>10,000)	~105	MARC 21	Audio preservation, historical recordings
43	China Music Repository (Hong Kong)	Hong Kong	https://www.hku.edu.hk/mus/	Small (<5,000)	~165	Dublin Core	Modern and contemporary focus
44	Taiwan Music Institute Digital Archive	Taiwan	https://www.ncfta.gov.tw/taiwan-musicinstitute_en/	Medium (5,000-10,000)	~280	Custom + Dublin Core	National cultural preservation project
45	Chinese Musicians Digital Project (Sydney)	Australia	https://www.sydney.edu.au/music/	Small (<5,000)	~72	MODS	Diaspora composers, oral history integration

Appendix 2: Content analysis instrument

DIGITAL MUSIC LIBRARY ASSESSMENT FORM

Researcher Name: _____

Institution Assessed: _____

Assessment Date: _____

Assessment ID: _____ (Sequential numbering 001-045)

SECTION 1: COLLECTION SCOPE AND COVERAGE

1.1 Total size of music collection

- Small (<5,000 items)
- Medium (5,000-10,000)
- Large (10,000-50,000)
- Very Large (>50,000)

Exact number if available: _____

1.2 Number of Chinese piano works identified: _____

Method of identification:

- Catalog search results
- Librarian estimate
- Collection-level documentation
- Combination of methods

1.3 Date range of Chinese piano music materials

Earliest work date: _____ Latest work date: _____

Coverage by historical period (check all that apply):

- Pre-1949 (Republican era and earlier)
- 1949-1965 (Early People's Republic of China)
- 1966-1976 (Cultural Revolution period)
- 1977-1999 (Reform and Opening era)
- 2000-present (Contemporary period)

1.4 Format types available (check all that apply)

- Printed scores (published editions)
- Manuscript scores (original or facsimile)
- Audio recordings (LP, CD, or digital)
- Video recordings (performance documentation)
- Program notes and performance materials
- Critical editions with scholarly apparatus
- Historical documents (letters, sketches)
- Analytical materials (dissertations, articles)

SECTION 2: METADATA STANDARDS AND SCHEMA

2.1 Primary metadata standard implemented

- MARC 21
- Dublin Core (with qualifiers)
- MODS (Metadata Object Description Schema)
- EAD (Encoded Archival Description)
- Proprietary/Locally developed system
- Mixed/Hybrid approach (specify): _____
- Other (specify): _____

2.2 Documentation of compositional techniques

Are Western compositional techniques systematically documented?

- Yes, systematically across entire collection
- Yes, for selected works or composers
- Occasionally, inconsistent practice
- Rarely or never documented

If documented, which elements are captured? (check all that apply)

- Musical form (sonata, rondo, ternary, etc.)
- Harmonic language and tonal practices
- Contrapuntal techniques
- Orchestration and texture descriptors
- Western genre classifications
- Developmental procedures (motivic, thematic)
- Performance techniques (extended techniques, pedaling)
- Other: _____

2.3 Documentation of Chinese cultural elements

Are Chinese musical and cultural elements systematically documented?

- Yes, systematically across entire collection
- Yes, for selected works or composers
- Occasionally, inconsistent practice
- Rarely or never documented

If documented, which elements are captured?

- Chinese melodic sources (folk songs, opera)
- Pentatonic scale usage and modal systems
- Cultural themes and programmatic content
- Literary references (poetry, classics)
- Philosophical concepts (Taoism, Confucianism)
- Folk music regional influences
- Revolutionary themes and socialist content
- Minority ethnic music influences
- Other: _____

2.4 Historical and political context documentation

Is historical/periodization information systematically included?

- Yes, comprehensive historical contextualization
- Yes, basic period identifiers provided
- Occasionally, for significant works only
- Rarely or never included

Level of detail provided:

- Broad era only (e.g., '20th century')
- Specific historical period (e.g., 'Cultural Revolution')
- Political/social context explicitly noted
- Compositional movement or school identified
- Composer's biography linked to historical events

2.5 Authority control implementation

Extent of authority control for names:

- Comprehensive (all personal and corporate names)
- Substantial (major composers and institutions)
- Partial (inconsistent application)
- Minimal or none

Authority files utilized:

- Library of Congress Name Authority File (LCNAF)
- Virtual International Authority File (VIAF)
- Chinese National Authority File

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- Local institutional authority file
- None/Manual entry only

2.6 Language support and romanization

Languages supported in interface and metadata:

- Chinese only (Simplified)
- Chinese only (Traditional)
- English only
- Bilingual (Chinese/English)
- Multilingual (three or more languages)

Romanization system for Chinese names and terms:

- Pinyin (consistently applied)
- Wade-Giles (consistently applied)
- Mixed/Inconsistent systems
- No systematic romanization
- Not applicable

2.7 Controlled vocabularies employed

Which standardized vocabularies are utilized? (check all that apply)

- Library of Congress Subject Headings (LCSH)
- Music Library Association controlled vocabularies
- Getty Art & Architecture Thesaurus
- Chinese Library Classification (CLC)
- Local/institutional thesaurus
- Free text only (no controlled vocabulary)
- Other (specify): _____

SECTION 3: SEARCH AND DISCOVERY FUNCTIONALITY

3.1 Basic search capabilities

Search interface type:

- Single search box only (keyword)
- Multiple search boxes (field-specific)
- Advanced search form with Boolean operators

Searchable metadata fields (check all that apply):

- Title (work or series)
- Composer name
- Date/Year of composition or publication
- Genre/Musical form
- Subject/Thematic content
- Full-text keyword (all fields)
- Technical/Analytical elements
- Publisher
- Instrumentation

3.2 Faceted navigation and filtering

Availability of faceted search refinement:

- No faceting available
- Basic faceting (2-3 facets)
- Moderate faceting (4-6 facets)
- Rich faceting (7 or more facets)

Available facets for refinement:

- Date/Period
- Composer
- Genre/Form
- Format type (score, recording, etc.)
- Language

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- Subject/Theme
- Collection/Series
- Other: _____

SECTION 4: OVERALL QUALITY ASSESSMENT

Rate each dimension on 1-5 scale (1=Poor, 5=Excellent):

Collection comprehensiveness for Chinese piano music: _____

Metadata quality and completeness: _____

Search functionality and user experience: _____

Documentation of cross-cultural elements: _____

Technical implementation and system performance: _____

TOTAL QUALITY SCORE: _____ / 25

2.2 The five-facet structure provides comprehensive coverage of essential metadata elements for Chinese piano music.

1-----2-----3-----4-----5-----6-----7

2.3 Implementation of this framework would be feasible in my institutional context.

1-----2-----3-----4-----5-----6-----7

2.4 This framework achieves appropriate balance between comprehensiveness and practical applicability.

1-----2-----3-----4-----5-----6-----7

2.5 The framework demonstrates sound theoretical grounding in knowledge organization principles.

1-----2-----3-----4-----5-----6-----7

2.6 This framework would enhance user discovery and access compared to current metadata practices.

1-----2-----3-----4-----5-----6-----7

PART 3: FACET-BY-FACET EVALUATION

For each of the five facets, please rate the following dimensions using the 7-point scale:

- ✓ Relevance: How relevant is this facet for organizing Chinese piano music?
- ✓ Completeness: How complete is the set of metadata elements within this facet?
- ✓ Practicality: How practical would this facet be to implement?

FACET 1: CULTURAL SYNTHESIS FACET

Metadata elements: Chinese melodic sources, Western harmonic language, modal integration, pentatonic usage, stylistic fusion techniques, folk music influences, philosophical/aesthetic concepts

3.1a Relevance of Cultural Synthesis Facet:

1-----2-----3-----4-----5-----6-----7

Not relevant Highly relevant

3.1b Completeness of Cultural Synthesis Facet elements:

1-----2-----3-----4-----5-----6-----7

Incomplete Complete

3.1c Practicality of implementing Cultural Synthesis Facet:

1-----2-----3-----4-----5-----6-----7

Not practical Very practical

3.1d Additional elements that should be included in Cultural Synthesis Facet:

[Open text response]

FACET 2: COMPOSITIONAL TECHNIQUE FACET

Metadata elements: Western techniques applied, form and structure, orchestration approaches, developmental procedures, counterpoint usage, harmonic progression, texture and voicing

3.2a Relevance of Compositional Technique Facet:

1-----2-----3-----4-----5-----6-----7

3.2b Completeness of Compositional Technique Facet elements:

1-----2-----3-----4-----5-----6-----7

3.2c Practicality of implementing Compositional Technique Facet:

1-----2-----3-----4-----5-----6-----7

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3.2d Additional elements or modifications for Compositional Technique Facet:

[Open text response]

FACET 3: HISTORICAL CONTEXT FACET

Metadata elements: Historical period, political environment, cultural movements, compositional trends, social context, revolutionary themes, institutional contexts

3.3a Relevance of Historical Context Facet:

1-----2-----3-----4-----5-----6-----7

3.3b Completeness of Historical Context Facet elements:

1-----2-----3-----4-----5-----6-----7

3.3c Practicality of implementing Historical Context Facet:

1-----2-----3-----4-----5-----6-----7

3.3d Additional considerations for Historical Context Facet:

[Open text response]

FACET 4: PERFORMANCE PRACTICE FACET

Metadata elements: Performance traditions, interpretive approaches, pedagogical uses, difficulty levels, competition suitability, ensemble contexts, idiomatic considerations

3.4a Relevance of Performance Practice Facet:

1-----2-----3-----4-----5-----6-----7

3.4b Completeness of Performance Practice Facet elements:

1-----2-----3-----4-----5-----6-----7

3.4c Practicality of implementing Performance Practice Facet:

1-----2-----3-----4-----5-----6-----7

3.4d Suggestions for Performance Practice Facet refinement:

[Open text response]

FACET 5: PROVENANCE AND ACCESS FACET

Metadata elements: Institutional holdings, manuscript locations, publication history, recording availability, archival collections, digital access, rights information

3.5a Relevance of Provenance and Access Facet:

1-----2-----3-----4-----5-----6-----7

3.5b Completeness of Provenance and Access Facet elements:

1-----2-----3-----4-----5-----6-----7

3.5c Practicality of implementing Provenance and Access Facet:

1-----2-----3-----4-----5-----6-----7

3.5d Additional provenance or access elements to consider:

[Open text response]

PART 4: IMPLEMENTATION CONSIDERATIONS

4.1 What do you perceive as the greatest challenges to implementing this framework in typical institutional settings?

[Open text response]

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4.2 What resources (training, tools, documentation) would be most critical for successful implementation?

[Open text response]

4.3 How compatible is this framework with existing metadata standards you currently use (MARC, Dublin Core, MODS, etc.)?

1-----2-----3-----4-----5-----6-----7

Not compatible

Highly compatible

4.4 Would you recommend this framework for adoption in your institution or professional community?

Definitely yes

Probably yes

Uncertain

Probably no

Definitely no

Please explain your reasoning: [Open text]

4.5 Additional comments, concerns, or suggestions for framework improvement: [Open text response]