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The CSCD method: A systematic innovation framework for cultural–technical contradictions—development and validation through culturally constrained content design

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Abstract

Systematic innovation methods resolve technical contradictions effectively but lack procedures for cultural–technical contradictions, in which scientifically accurate information conflicts with cultural taboos. Such contradictions pervade sensitive domains, including sexuality education, mental health, and death education, where feasibility depends on both scientific integrity and social acceptance. Theory of Inventive Problem-Solving (TRIZ) addresses physical contradictions but cannot operationalize cultural constraints, while participatory design lacks algorithmic protocols for conflicting stakeholder standards. This study develops the culturally constrained sensitive content design (CSCD) method, a five-module framework with formalized decision protocols that operationalizes cultural adaptation through tiered content architecture, metaphor-based narratives, de-realization techniques, and multi-stakeholder validation. The framework was validated through interviews with 20 children and a 7-expert focus group, using sex education comics in southern China as an extreme-constraint case. The CSCD method offers the first algorithmic framework for cultural–technical contradictions, with structural analogies suggesting transferability to mental health, death, and financial literacy education pending future empirical validation. It provides replicable procedures for materials that require both scientific accuracy and cultural acceptance, operationalizes cultural adaptation into designable parameters, and indicates potential transferability to other sensitive domains requiring multi-stakeholder validation.

Keywords: Systematic innovation; Cultural–technical contradictions; Culturally constrained sensitive content design (CSCD) method; Algorithmic design protocols; Cross-domain transferability

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1. Introduction

Systematic innovation methods have matured in resolving technical contradictions through formalized procedures, yet cultural–technical contradictions remain underexplored. In such contradictions, scientific accuracy requires content that violates cultural acceptability, and multiple stakeholder groups hold incompatible success criteria. This pattern recurs in sensitive domains such as sexuality education, mental

health communication, death education, and financial literacy, where feasibility depends equally on accuracy and social acceptance. Current design practice in these areas relies on intuition rather than systematic procedures, creating a methodological gap that limits design quality and cross-domain knowledge accumulation.

Existing frameworks address parts of this challenge but remain insufficient. Theory of Inventive Problem-Solving (TRIZ) resolves technical contradictions through separation and inventive principles, but assumes physics-driven rather than culturally driven constraints. McCloud's (1993) six-step theory offers general guidance on comic design but does not address cultural sensitivity. User-centered and participatory design emphasize stakeholder involvement but provide limited algorithmic guidance when acceptability thresholds conflict. Health communication frameworks plan behavioral change but do not address cultural taboos that prevent information dissemination. This gap calls for a systematic approach that formalizes cultural adaptation into replicable procedures, provides decision protocols for sensitivity-accuracy trade-offs, and supports cross-domain transferability.

This study develops the culturally constrained sensitive content design (CSCD) method, a five-module framework spanning content architecture, pedagogical strategy, narrative design, visual representation, and multi-stakeholder validation, each governed by formalized decision protocols. By transforming intuitive judgments into replicable procedures, the method extends systematic innovation theory beyond engineering domains into social innovation scenarios where cultural acceptance shapes implementation feasibility.

To validate the method under extreme cultural constraints, this study uses sex education comics in southern China as the primary case, where scientific accuracy directly conflicts with deeply rooted taboos. Despite policy initiatives such as the Implementation Outline of Sex Education in Primary and Secondary Schools (Ministry of Education of the People's Republic of China, 2021), implementation is limited by resource constraints, cultural conservatism, and societal avoidance (Zhou, 2024). The absence of systematic school-based programs leaves children dependent on informal sources, leading to cognitive confusion (Ji and Reiss, 2022), while persistent issues such as child sexual abuse and teenage pregnancy indicate unmet needs (China Children's Culture and Art Foundation & Beijing Zhongyi Public Welfare Foundation, 2022). Science comics offer a promising medium, with demonstrated effectiveness for sensitive information (Winarto *et al.*, 2018), exemplified internationally by *Not Your Mother's Meatloaf: A Sex Education Comic Book* (Miller

& Bley, 2013) and *Cells at Work! CODE BLACK* (Shimizu, 2015). This research bridges general design theory with the specific requirements of culturally constrained content.

2. Literature review

2.1. Sex education

Sex education is conceptualized here as a comprehensive process addressing physiological, psychological, and sociocultural dimensions. The International Technical Guidance on Sexuality Education (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2018) and the Comprehensive Sexuality Education guidance (World Health Organization [WHO], 2023) recommend introducing sex education in early childhood and progressively developing it as children's cognitive development progresses. Building on this principle, the present study aims to provide a sex education comic method that guides practitioners, illustrators, and publishers in producing materials that are cognitively appropriate, culturally sensitive, and effective in disseminating knowledge of sexual health and gender equality.

Despite global progress in sex education, gaps in availability and quality remain considerable. Many programs still emphasize physiological and reproductive knowledge while neglecting gender equality, gender identity, and emotional education (Jacquerye & De Sutter, 2023), and cultural taboos and religious beliefs frequently constrain curricular content (UNESCO, 2021).

China is no exception. National policies, including the Minor Protection Law (National People's Congress of China, 2020) and the Guidelines on Health Education in Primary and Secondary Schools (Ministry of Education of the People's Republic of China, 2008) have gradually aligned with the UNESCO Comprehensive Sexuality Education framework (UNESCO, 2021), expanding curricula beyond physiological topics to include gender equality, emotional education, and gender identity. However, practical coverage remains uneven.

Implementation is constrained by cultural conservatism and traditional gender norms. Sexual topics are often avoided in family and school settings, leading to fragmented and self-directed learning. Many parents and educators lack professional knowledge or communicative skills, and some perceive sex education as unnecessary or as encouraging early sexual activity (Li *et al.*, 2022; Zheng & Chen, 2010). Beyond cultural perception, sex education is often misframed as a sensitive topic, obscuring its developmental importance for children. Effectiveness also varies due to inadequate teacher training, limited

resources, and low parental involvement, with rural schools particularly underserved (China National Children's Center, 2023).

Overall, although China has advanced in policy, practical implementation continues to face significant barriers, underscoring the need for educational strategies that can systematically overcome them.

2.2. Science comic

Science comics are a comic genre primarily oriented toward scientific content (Farinella, 2018). Through illustration, sequential narrative, and character personification, they translate abstract or complex ideas into accessible visual stories, increasing engagement and comprehension among young readers (Figure 1) (Bramlett *et al.*, 2016; Czerwiec *et al.*, 2020; Farinella, 2018).

Building on these features, science comics offer several pedagogical benefits. They integrate knowledge across disciplines within a single narrative, supporting deeper conceptual understanding (Tavares *et al.*, 2023).

Their visual and interactive nature reduces language and cultural barriers, making them affordable and equitable learning tools (Farinella, 2018), with practical value for low-income and under-resourced contexts in China. They also lower communication barriers around sensitive topics by employing metaphorical and low-conflict language, providing a more acceptable pathway for content related to sexuality, the body, and gender (Boer, 2020).

Science comics are particularly suited to sex education, where metaphorical and gentle language facilitate communication in both home and school settings, with lower obtrusiveness than traditional didactic methods. Soft narratives align better with children's cognitive development and enhance their willingness to engage with topics such as gender, sexual health, and emotional expression (Faria *et al.*, 2024). However, achieving effectiveness requires careful balancing of scientific rigor, artistic expression, and cultural sensitivity (Wiseman *et al.*, 2021), a challenge particularly acute for sex education comics in China.

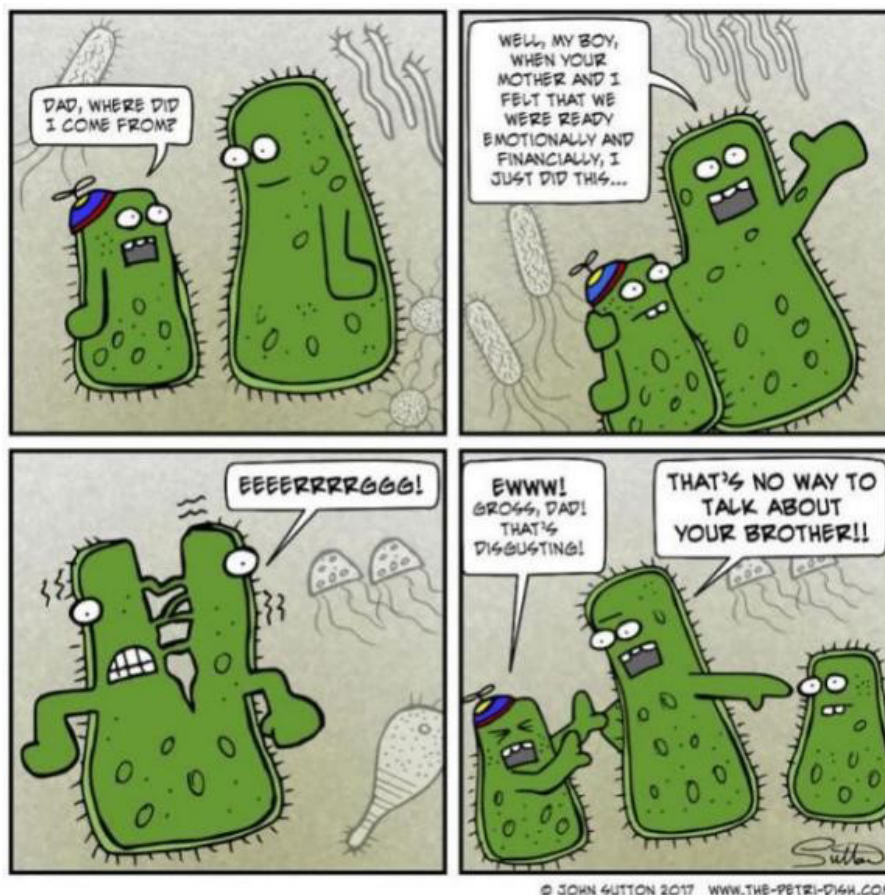


Figure 1. A humorous depiction of bacterial reproduction through binary fission in a science comic. Image reprinted from Sutton (2019).

In China, sex education comics face cultural taboos, censorship, and limited systematic design, with several titles withdrawn following public controversy over perceived inappropriateness (Chen, 2022). Localized titles such as *My Body is Changing* illustrate how physiological change can be presented to children through gentle, age-appropriate visual narratives (Figure 2). International examples likewise demonstrate accessible approaches to sensitive anatomy, as in *Menstrupedia's* child-oriented explanation of female reproductive anatomy (Figure 3). Existing materials often lack instructional design and assessment systems for balancing scientific accuracy with emotional support (Farinella, 2018), hindering their adoption in schools. International practices offer guidance: *TeachAIDS*, though not in comic form, demonstrates how scientific rigor, cultural sensitivity, and clear educational objectives can overcome similar concerns (Figure 4) (Sorcar, 2009; Sorcar *et al.*, 2017), and its cross-cultural adaptability has been shown to transfer (Boer, 2020). Future Chinese sex education comics should integrate health communication theory with cultural localization, be grounded in local needs, balance scientific accuracy with culturally appropriate presentation, and respect local sensitivities to enable broader implementation. The present study therefore develops a culturally appropriate

CSCD method to support the implementation of sexual health education in southern China.

2.3. Cultural–technical contradictions as an innovation challenge

Traditional systematic innovation methods, notably TRIZ, address technical contradictions in which improving one parameter degrades another, and physical contradictions requiring contradictory states simultaneously. Cultural–technical contradictions, by contrast, involve subjective, context-dependent constraints with multiple stakeholders maintaining incompatible success criteria.

The TRIZ separation principles partition conflicting requirements across time, space, or conditions, while inventive principles guide system modifications. Recent applications confirm TRIZ's continued effectiveness, from shape-memory polymers to business model innovation (Iqbal & Rahman, 2025; Mejia-Duque & Guerrero-Alvarado, 2025). However, these strategies presuppose physical separability and objective constraints. Temporal or spatial separation cannot resolve contradictions when cultural taboos prohibit the disclosure of information itself, and TRIZ lacks procedures for translating culturally driven subjective constraints into designable parameters.



Figure 2. Illustration from pages 7 and 8 of *My Body is Changing*, focusing on children's understanding of this physiological change. Image reprinted from Nojima (2022).



Figure 3. A comic page from Menstrupedia explaining female reproductive anatomy to children. Image reprinted from Gupta and Paul (2014).

Design thinking emphasizes empathy and iterative prototyping to surface user needs (Dell’Era *et al.*, 2025). It excels at exploration but offers limited algorithmic guidance when stakeholder empathy reveals fundamentally conflicting requirements. When parents demand information suppression while educators require accuracy, iteration alone cannot resolve the conflict of values. Recent reviews indicate that although design thinking enhances creativity, its reliance on designer intuition prevents the formalization of replicable procedures (Mayer *et al.*, 2025; Rösch *et al.*, 2023).

Participatory design involves stakeholders in co-creation and addresses power imbalances through diverse participatory techniques across design stages (Wacnik *et al.*, 2025), yet it lacks formalized protocols for managing incompatible acceptability standards across stakeholder groups.

Health communication frameworks plan behavioral change but typically assume that information can be communicated once appropriate framing is identified, leaving unaddressed those scenarios in which cultural taboos prevent dissemination regardless of framing (Green & Kreuter, 2005).

Collectively, existing methods provide useful tools but lack integrated frameworks for cultural–technical contradictions. The literature reveals consistent gaps in formalized cultural adaptation procedures, algorithmic decision protocols, quantifiable risk metrics, and structured conflict–resolution mechanisms, motivating a specialized systematic innovation method that operationalizes

subjective cultural constraints into objective design parameters.

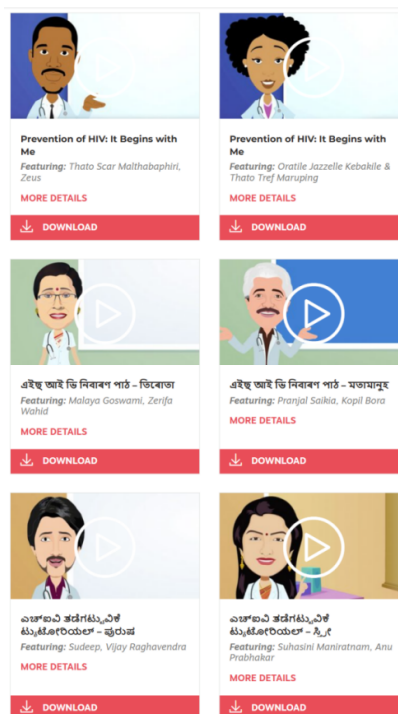


Figure 4. TeachAids’ animated resource page on HIV prevention, featuring multiple language versions of animated videos. These videos highlight characters from different cultural backgrounds and aim to raise awareness of HIV prevention through educational content. Source: TeachAids (n.d.)

2.4. Systematic innovation in culturally constrained design

Building on the recognition that existing innovation methods insufficiently address cultural–technical contradictions, prior scholarship has examined specific aspects of cultural adaptation. Hofstede’s (1983) cultural dimensions theory offers analytical frameworks for understanding cross-cultural differences but lacks actionable guidance for translating cultural insights into design decisions. Recent work on taboo-breaking design suggests metaphorical language and visual abstraction to reduce psychological resistance, but these tactics remain fragmented rather than integrated into validated methodologies. The present study addresses this gap by integrating comic design theory, cultural adaptation strategies, and systematic innovation principles into a unified methodology, grounded in empirical investigation of sex education in conservative Chinese contexts and oriented toward generalizability across culturally sensitive educational scenarios.

2.5. Theoretical framework

This research adapts systematic innovation principles to cultural–technical contradictions by integrating innovation methodology with visual communication design. TRIZ-based approaches resolve contradictions through separation principles that divide conflicting requirements across temporal, spatial, or conditional dimensions (Iqbal & Rahman, 2025). Applied to culturally constrained content, these principles translate into tiered architectures that separate information by sensitivity level, enabling progressive disclosure that reduces psychological resistance while preserving scientific accuracy. The method extends this approach by introducing metaphorical representations as cultural mediators, functioning analogously to TRIZ intermediary elements that transform incompatible system states into compatible solutions.

The CSCD method comprises five integrated modules: Module 1 establishes educational objectives and identifies cultural boundaries; Module 2 formulates pedagogical strategies, including storytelling and tiered disclosure; Module 3 develops culturally embedded narratives with metaphorical representations; Module 4 applies visual design, balancing accuracy with acceptability; and Module 5 implements multi-stakeholder validation. The mapping between the 40 TRIZ inventive principles (Altshuller, 1999) and the CSCD modules is explicit rather than analogical. The tiered architecture in Module 1 operationalizes temporal separation together with Principle 7 (nested doll), embedding sensitive content within progressively disclosed layers aligned with developmental stages.

The moderately advanced pedagogy in Module 2 applies Principle 10 (preliminary action), introducing psychological preparation prior to biological change. The metaphor-based narrative in Module 3 instantiates Principle 24 (intermediary), with metaphorical characters mediating between scientific content and cultural taboos. The de-realization strategy in Module 4 combines Principles 26 (copying) and 3 (local quality), substituting stylized representations for anatomically realistic imagery and applying abstraction selectively to sensitive elements. Module 5 reflects the TRIZ concept of ideality with Principle 13 (the other way round), maximizing acceptance across stakeholder groups rather than minimizing isolated objections. The algorithmic decision protocols parallel the logic of the TRIZ contradiction matrix, with content sensitivity and cultural risk functioning as the two axes governing prescribed strategy configurations. The method thus extends the TRIZ tradition into culturally driven subjective constraints rather than departing from it.

McCloud’s (1993) six-step theory provides domain-specific guidance for comic design through six dimensions: idea, form, style, structure, craft, and surface. The theory has demonstrated effectiveness in organizing scientific information and storyboards for health communication (Figueiredo, 2011; Luz *et al.*, 2023), with applications across information design contexts (Kremer, 2017; Preston & Thomassen, 2010). However, it focuses on artistic creation without addressing culturally constrained resolution or pedagogical effectiveness for sensitive content. The CSCD method operationalizes McCloud’s principles into systematic procedures with formalized decision protocols and quantifiable evaluation metrics, embedding cultural constraint analysis within the idea and form stages, formalizing style choices through algorithmic de-realization, and incorporating multi-stakeholder validation absent in the original model. This integration converts tacit design expertise into explicit, replicable procedures while maintaining the core principle of algorithmic problem-solving.

3. Methodology

This research employed qualitative methods to develop a systematic innovation methodology for culturally constrained sensitive content. Beyond understanding the phenomenon, the study transformed empirical insights into formalized innovation procedures, operationalizing qualitative findings into algorithmic steps, decision protocols, and evaluation metrics, thereby converting situated knowledge from focus group discussions into transferable methodological components. Following an interpretive approach (Creswell & Creswell, 2018), inductive data analysis was used to integrate the themes

and design principles required for framework construction.

To ground the methodology in user-centered principles, the preliminary phase conducted semi-structured interviews with 20 children in Dongguan to identify experiential factors for subsequent procedural formalization. As a southern Chinese city with diverse family structures, Dongguan offered insights across different family backgrounds. Inductive analysis identified key characteristics and core design elements influencing children's learning experiences with sex education comics; for example, children clearly preferred anthropomorphic characters and rejected didactic narratives. These findings were summarized as stimulus material for a seven-member focus group, mainly drawn from Guangdong, comprising an illustrator, a children's education expert, a publishing editor, a designer, a teacher, and two parents. Drawing on prior research on children's reading experiences, members discussed educational value, design elements, and cultural adaptability. Thematic analysis (Braun & Clarke, 2006) synthesized these data into innovation principles and procedural components, employing both deductive coding aligned with McCloud's (1993) framework and inductive coding to identify emergent cultural constraint resolution strategies. NVIVO 15 (Lumivero, United States) supported the coding and theme construction.

3.1. Sampling

Purposive sampling was used to ensure that participants could provide diverse, informed feedback on the framework (Creswell & Poth, 2018). One online focus group of seven participants was conducted, consistent with the 5–8 person range recommended by Krueger and Casey (2015) and the 4–6 person range suggested by Stewart and Shamdasani (2017).

Participants included two parents, a primary school teacher, a child education expert, a children's book editor, a graphic designer, and an illustrator. Parents and the teacher assessed acceptability and educational value from family and school perspectives; the educational expert evaluated learning outcomes from a cognitive-developmental perspective; the editor assessed readability and publication feasibility; and the designer and illustrator evaluated typography, character design, and visual narrative. This composition ensured comprehensive multi-perspective feedback. Participant information is shown in Table 1.

3.2. Selection criteria

To ensure relevant experience, this study established selection criteria based on purposive sampling. Parents were required to have at least one child aged 9–12, providing insight into family receptiveness and concerns. The teacher

was required to have several years of teaching experience, preferably in health education. The children's education expert was required to have a professional background in education or developmental psychology with research or practical experience in children's learning and social-emotional development. The children's book editor was required to have at least 10 years of publishing experience with the ability to evaluate readability, accessibility, and age appropriateness. The graphic designer and illustrator were required to be professionals with experience in children's projects, providing feedback on layout, typography, character design, and visual storytelling.

Table 1. Focus group members' information

Participant ID	Age	Gender	Role/Profession
P1	38	M	Parent
P2	34	F	Parent
T1	40	F	Teacher
E1	45	F	Children's education expert
PE1	43	M	Children's book publishing editor
I1	31	F	Illustrator
D1	29	F	Graphic designer

Abbreviations: F: Female; M: Male.

3.3. Data collection procedure

The focus group was conducted online in February 2025 during the Chinese winter holiday. Following ethical protocols, all participants signed informed consent forms before the discussion, were informed of the study's purpose and procedures, and were assured of voluntary participation, confidentiality, and that their data would be used solely for academic research.

The discussion was semi-structured: a prepared question list ensured coverage of essential issues while allowing open contribution, and the moderator guided dialogue to maintain focus and encourage interaction. Discussions were audio-recorded with consent, with key points also noted.

In the introduction, the researcher summarized findings from the children's interviews, including their main emotional responses to reading sex education comics, as well as design factors that shaped their learning experience: visual appeal, character approachability, narrative simplicity, and entertainment value. These cues

focused subsequent discussion on how comic design could be improved for educational impact.

Focus group members integrated children's input with their professional expertise to recommend improvements aligned with both educational needs and children's cognitive habits.

The study received ethical approval from the Human Research Ethics Committee for Non-Clinical Faculties, School of Psychology, South China Normal University (Approval Number: SCNU-PSY-2024-087; Approval Date: April 3, 2024) and adhered to the principles of the Declaration of Helsinki.

4. Result: The culturally constrained sensitive content design (CSCD) method

Through the systematic analysis of focus group discussions and children's feedback, this research developed the CSCD method, a systematic methodology for sensitive educational content under cultural constraints. The method comprises five integrated modules: Module 1 establishes educational objectives and identifies cultural boundaries; Module 2 formulates pedagogical strategies including storytelling and tiered disclosure; Module 3 develops culturally embedded narratives with metaphorical representations; Module 4 applies visual design balancing accuracy with acceptability; Module 5 implements multi-stakeholder validation. Each module includes decision checkpoints, and the method operates iteratively to refine content when validation reveals conflicts. Although validated through sex education comics in southern China, the method addresses challenges common to culturally constrained domains: maintaining scientific integrity while achieving social acceptance, progressively introducing uncomfortable information, and balancing diverse stakeholder concerns. [Figure 5](#) illustrates the overall process and decision flow.

The method was developed through a thematic analysis that combined deductive and inductive approaches. Deductive coding, aligned with McCloud's (1993) six-step framework, organized data into preliminary themes of educational intent, pedagogical form, narrative structure, and visual presentation. Inductive analysis then identified emergent concepts not directly addressed by existing theory, particularly localization strategies, parental acceptance dynamics, and social taboos, consolidated into a fifth theme of cultural adaptation. This hybrid analysis transformed focus group insights into the five-module CSCD structure:

- (i) Module 1: Content architecture and learning objectives
- (ii) Module 2: Pedagogical strategy formulation
- (iii) Module 3: Narrative and character design

- (iv) Module 4: Visual and interactive design
- (v) Module 5: Multi-stakeholder validation and cultural adaptation

4.1. Module 1: Content architecture and learning objectives

Module 1 operationalizes TRIZ temporal separation together with Principle 7 (nested doll), partitioning content across developmental stages and embedding sensitive elements within progressively disclosed layers. The module defines the educational vision and scope, ensuring scientific accuracy, age-appropriateness, and systematic structure. Focus group discussions indicated that sex education should begin with basic physiology and progress through social, psychological, ethical, and legal dimensions.

Physiological development and health serve as the starting point. Content on adolescent changes and healthcare skills should be delivered progressively. As P1 noted, systematic and natural delivery alleviates anxiety toward unfamiliar changes while equipping children with practical hygiene skills. Content should also incorporate gender awareness and social education to promote inclusive and equitable values. T1 emphasized that character and abilities are not defined by gender, challenging stereotypes such as "strong girls" and "gentle boys." Topics such as friendship, family, and early emotional relationships should help children develop healthy social interaction norms.

Beyond physical development, the module addresses psychological and emotional support. To address anxieties arising from differing developmental rhythms among peers, E1 noted that comics should depict characters at varied developmental milestones, normalizing differences in pace and providing emotional resonance and psychological reassurance.

Sex ethics and safety education become increasingly important as children develop socially. P1 and T1 highlighted relationship boundaries, online safety, and community health. They argued that comics should illustrate responsibility and respect through situational contexts (such as dealing with school rumors), helping children recognize behavioral consequences and make responsible choices.

Finally, content should foreground self-protection skills and basic legal literacy. T1 suggested using real-life scenarios to demonstrate identifying danger, refusing inappropriate contact, and seeking help, while P1 emphasized the importance of providing concrete response strategies for moments of risk.

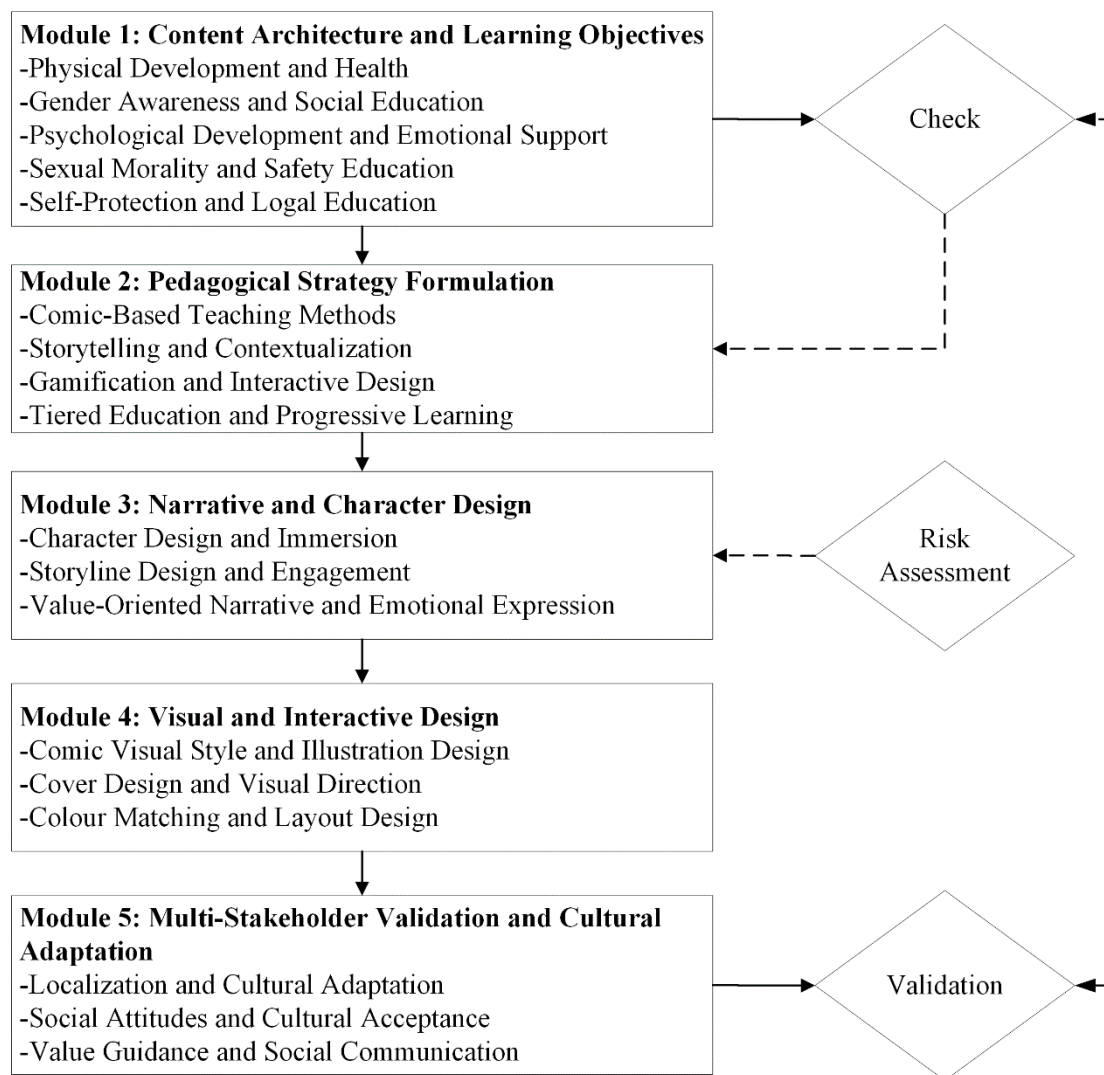


Figure 5. The culturally constrained sensitive content design (CSCD) method. A systematic innovation framework with algorithmic decision checkpoints. Five integrated modules for resolving cultural–technical contradictions in sensitive content domains.

4.2. Module 2: Pedagogical strategy formulation

Module 2 draws on TRIZ Principle 10 (preliminary action): psychological preparation precedes biological and social events, neutralizing anxiety in advance of developmental change. Comic-based teaching is the central strategy. Experts agreed that combining text and images significantly lowers cognitive barriers. PE1 observed that text-only sex education books bore children, whereas the comic format is more appealing and easier to accept:

In case sex education books are presented solely through text, children are likely to get bored and lose interest in reading these books. Thus, in my opinion, sex education presented in the comic form is more appealing and easier for children to

accept. (PE1)

Comic design must be entertaining, accessible, and educational. E1 and P2 suggested replacing memorization tasks with summary or question sections at the end of each chapter. E1 also stressed that language should avoid technical terminology beyond children’s reach. D1 emphasized that comics should not be didactic, while T1 argued that children should learn through exploration of stories that allow implicit, natural absorption.

Storytelling and conceptualization are equally important. PE1 cited the *Adventure of Xiao Wei*, in which complex biological processes such as fertilization are recast as adventure narratives, as evidence of effective comprehension support. T1 added that primary school

students learn better from contextualized than rote learning. Accordingly, E1 recommended setting scenarios in familiar environments (e.g., home, school) and using metaphor and personification (e.g., hormones as messengers) to make information relatable. D1 and T1 added that characters must possess personalities and developmental struggles so that children can develop empathy alongside socialization.

To increase engagement, the method incorporates gamification and interactive design. E1 suggested replacing passive reception with interactive techniques that promote active exploration, recommending, in particular, that conventional classroom activities be substituted with interactive games for sensitive content: “Especially in the delivery of sex education materials, the conventional learning activities in classrooms ought to be substituted with interactive games.”

Several interactive structures were proposed. Physically, D1 suggested page-turning interactions using transparent overlays to gradually disclose body structures, reducing psychological pressure. T1 proposed a companion card game to extend interactivity. Digitally, D1 and PE1 suggested augmented reality (AR) technology for an immersive experience. These designs aim to support self-protection skills while providing a sense of accomplishment.

Underlying all strategies is tiered, progressive learning. Members emphasized that content should be strictly age-stratified by cognitive stage to prevent overload. Building on this, the method advocates a “moderately advanced” approach. E1 argued that introducing relevant knowledge before adolescence creates a psychological buffer that reduces puberty-related anxiety; the challenge lies in helping children understand the concepts. P1 and P2 supported this view but emphasized the need to balance presentation with accuracy. To implement a tiered design, P2 and E1 recommended a phased terminology approach: simple metaphors at younger ages progressing to scientific terms as children mature:

Sex education may adopt a moderately advanced approach. Children acquiring this knowledge before entering adolescence can help them to have a mentally preparation, reducing the anxiety and worries that may appear during puberty. This approach is very beneficial. The key is how to help children better understand these concepts. (E1)

4.3. Module 3: Narrative and character design

Module 3 instantiates TRIZ Principle 24 (intermediary): metaphorical characters and personified narrative agents mediate between scientifically accurate content and cultural acceptability thresholds. The module guides narrative and character design to enable natural transmission

and internalization of culturally constrained knowledge through immersive, engaging, value-driven story worlds.

At the level of character design and immersion, the method emphasizes diverse, continuous, and approachable characters. As I1 suggested, diverse representation is foundational to immersion: comics should feature characters with multiple independent storylines, varied appearances, body types, and heights to mirror children’s everyday reality:

In comic design, it is advisable to create diverse characters with multiple independent storylines to enhance children’s sense of immersion significantly. At the same time, these characters should have diverse appearances, such as different body types and heights, to reflect the real-life situations in children’s everyday life as closely as possible. (I1)

T1 added that personalities should break gender stereotypes, allowing children with different temperaments to identify with the characters. To preserve narrative continuity, D1 and E1 recommended a stable main protagonist, a preference echoed in children’s feedback. The method also proposes personified “reading buddies” such as small animals; children’s feedback indicated that this design eases psychological defenses and fosters a relaxed, friend-like reading atmosphere.

At the storyline level, the method combines education with entertainment. T1 and I1 noted that dramatic narratives stimulate learning motivation more effectively than direct exposition. E1 cautioned that fragmented plots or frequent character changes confuse children and impair retention; children themselves preferred “more connected and longer” stories. Every scene should serve edutainment, ensuring knowledge is absorbed naturally. As E1 emphasized, overt educational framing can make children unwilling to read, “Story design should avoid overtly education[al] elements. If children feel that they are being educated when they read the comic, they may become unwilling to read it.” T1 added that, given children’s existing academic load, sex education comics should not feel like another textbook but should support relaxed learning.

Finally, narratives should be value-oriented and emotionally expressive. E1 and T1 viewed comics as both knowledge media and value-shaping tools. From an innovation perspective, D1 encouraged creators to adopt a child’s perspective rather than a top-down presentation. Story selection should be values-driven; as E1 emphasized, sex education must not only explain science but also guide young people toward healthy attitudes toward love

and reproduction, avoiding fear-based framings of sex, relationships, and reproduction:

Sex education is not just about teaching knowledge and science, but also incorporate[s] the right values. Sex education comics can help children develop healthy attitudes towards love and reproduction... Children should not be taught to regard sex, relationships, and reproduction with fear, preventing them from developing overly negative thoughts about the future. (E1)

T1 further recommended drawing on positive cultural stories. Children's feedback confirmed that humanistic narratives reduce anxiety and foster acceptance of sensitive content.

4.4. Module 4: Visual and interactive design

Module 4 combines TRIZ Principles 26 (copying) and 3 (local quality): stylized visual substitutes replace anatomically realistic imagery, with abstraction applied locally to sensitive elements while overall realism is preserved. For sensitive topics such as reproductive organs, the method employs a "de-realization" strategy that creates a psychological buffer through cartoon-style representation. As I1 suggested, illustrations of reproductive organs should avoid overly realistic imagery; flat, cartoon-style, fluent lines feel more relaxed and approachable while still conveying knowledge effectively. D1 further recommended partial or symbolic representations to avoid direct visual impact. T1 emphasized aesthetically pleasing, positive illustrations to avoid unnecessary negative emotions, and E1 noted that visuals should align with the tiered content structure to prevent discomfort. I1 added that style should adapt to context; serious topics such as sexual abuse prevention require more serious art and tone to convey gravity:

When illustrating reproductive organs, it is suggested to avoid overly realistic pictures to avoid causing fear in children. A flat, cartoon style with fluent lines can be used to make children feel more relaxed and approachable while effectively presenting knowledge. (I1)

For color and layout, comics should establish a clear reading-navigation system to support efficient learning. Aesthetically, I1 proposed doodle and hand-written elements suited to children. D1 recommended visual rhythm through font size and style variation. To address layout confusion common among first-time readers, D1 suggested small arrows or numerical markers in complex panels to ease memory load, with a strict information hierarchy enforced through fonts, colors, and storyboards to enable rapid information capture.

Members also offered cover design recommendations as the first impression must be both attractive and contextually appropriate. Bright colors and humorous characters were widely endorsed by both experts and children. D1, however, warned that covers must avoid overt sexual imagery that makes children feel embarrassed. Children's feedback confirmed that cover nudity generates shame and discourages reading in public settings. Covers should also balance visual clarity and information hierarchy. In response to children's complaints about complex layouts, D1 recommended simplified layouts that clearly convey primary information, supporting both a relaxed reading atmosphere and a strong first impression: "The cover designs must not have overt sexual designs, which can make the kids feel embarrassed or awkward."

The feedback from children directly supports this point of view. According to them, the nudity on the cover generates a feeling of shame that prevents them from reading it in public. In addition, the cover must balance the visual, ensuring that the information is clear and that priorities are clearly defined. In response to children's complaints of complex and confusing layouts, D1 claimed that covers should be designed to convey primary information in a simplified layout. This not only provides a tense-free, easy-to-read atmosphere but also has a substantial effect on the first impression of the reader.

4.5. Module 5: Multi-stakeholder validation and cultural adaptation

Module 5 reflects the TRIZ concept of ideality with Principle 13 (the other way round): the procedure maximizes acceptance benefits across stakeholder groups, balancing cultural risk costs rather than minimizing objections from any single group. Content must be localized and culturally adapted for effective implementation. Focus group discussions indicated that this is not merely linguistic translation but a question of cultural legitimacy. As PE1 cautioned, identical content can be received well in one cultural context and trigger conflict in another:

Variations in the world and cultural orientations have diverse views and degrees of acknowledgement of sex education. The same content could be perceived as a good one in a given culture, and the same could be a source of conflict in a different area. (PE1)

The method therefore presupposes systematic planning from the earliest design stages. For cultural-content integration, D1 suggested using familiar local cultural elements (e.g., traditional stories or internet slang) to build familiarity, while PE1 highlighted parents' role as gatekeepers: stories misaligned with local norms (for

example, depictions of mothers and children bathing together typical of Japanese family life) directly violate cultural taboos and provoke parental resistance and child alienation. For content arrangement, E1 recommended brevity and clarity, avoiding complex or negative metaphors, and T1 stressed that all cultural elements should reinforce positive and healthy values. These efforts should be grounded in rigorous cultural review and research-driven design. E1 emphasized that all content must match children's psychological developmental stage. PE1 further recommended involving experts, scholars, and parent representatives from diverse cultural backgrounds in content review from the outset.

Second, content design must be handled carefully regarding social attitudes and explicitness. PE1 noted that although national law protects scientific popularization of sensitive content, presentation remains key to social and psychological acceptance. P1 expressed clear concern that overly explicit images (such as direct depictions of intercourse) may cause confusion or discomfort in children lacking sufficient background knowledge. Presentation must therefore align with children's cognitive capacity.

To calibrate explicitness, the method adopts T1's progressive principle through age-based tiering of sensitive content. As T1 explained, primary school sex education typically focuses on basic anatomy, while complex topics such as intercourse are introduced later in primary school (Year 6, ages 12–13) or in secondary school. This phasing aligns scientific accuracy with mainstream cultural norms and children's learning trajectory, improving both acceptance and reducing social resistance to implementation:

In primary school, sex education usually focuses on basic knowledge of the sexual organs. More complex topics, such as sexual intercourse, are often taught later in primary school (for example, in Year 6, aged 12–13) or during secondary school. This plan will be scientifically accurate as well as strike a balance between the mainstream cultural norm and the way children learn. Hence, not only does it allow improving the level of understanding and acceptance of the content, but [it] also makes it possible to decrease social resistance to its application. (T1)

Finally, the method emphasizes value guidance and social communication. E1 and T1 viewed comics as both knowledge sources and tools for cultivating healthy values, with respect, responsibility, and positive emotion woven naturally into stories. In gender-related matters, this orientation translates into values of equality and mutual understanding. Rather than rigidly separating gender-

specific content, the method organizes information to foster cross-gender understanding. As T1 explained, sex education for boys and girls should not be wholly distinct, since both will mature and may have siblings, making mutual understanding of physiological change important: "The content of sex education for boys and girls must not be totally different. As they will both mature and may have siblings, and, therefore, it is important for them to know about the physiological changes of one another." P1 and P2 confirmed that detailed knowledge of gender issues helps overcome growth-stage barriers and misunderstandings.

Accordingly, the method calls for stronger education in healthy emotions and values. E1 argued that comics should help children interpret relationships, love, and family in a positive light rather than fixate on dangers and adverse outcomes. Comics can complement school-based education by modeling healthy interpersonal relationships and raising social awareness of positive educational approaches.

4.6. Algorithmic decision protocols

The CSCD method formalizes previously subjective judgments into measurable parameters: sensitivity scores quantify content risk, acceptance rates measure stakeholder approval, and cultural risk assessments evaluate conflict probability. These parameters operate through two core algorithms, sensitivity-based strategy selection and cultural-risk iteration, that transform cultural adaptation from tacit practice into a structured procedure amenable to cross-domain transfer.

The decision protocols emerged from analysis of expert reasoning during focus group discussions and guide strategy selection based on content characteristics and cultural context. Sensitivity assessment formed the primary decision node: high-sensitivity content, such as sexual intercourse and body imagery, triggers maximum metaphorization combined with enhanced multi-stage validation; medium-sensitivity topics, such as physiological change, use hybrid approaches blending direct explanation with metaphorical framing; and low-sensitivity content allows direct factual presentation. Cultural risk evaluation forms a secondary checkpoint: when expert assessments indicate cultural conflict risk above the threshold (operationalized as scores above 7 on a 10-point scale in this study), the process returns to Module 3 for narrative redesign. Stakeholder acceptance is the final validation gate: content proceeds to implementation only when all stakeholder groups meet predetermined thresholds, set at 70% in this research context but adjustable for other settings. Figure 6 illustrates these decision pathways and return loops.

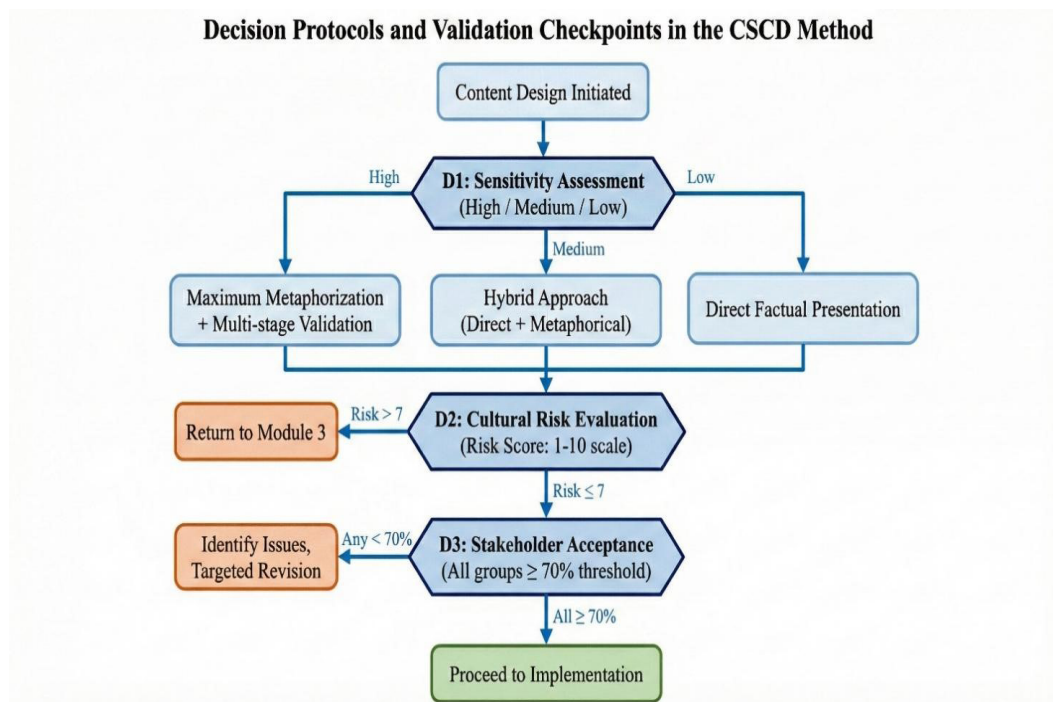


Figure 6. Algorithmic decision protocols for cultural–technical contradiction resolution. The decision tree illustrates three critical assessment points: (D1) a sensitivity assessment to determine metaphorization intensity, (D2) a cultural risk evaluation with threshold-based iteration triggers, and (D3) a multi-stakeholder validation to ensure comprehensive acceptance. Orange boxes indicate required corrective actions when validation criteria are not met. Abbreviation: CSCD: Culturally constrained sensitive content design.

5. Discussion

The following discussion examines the method’s theoretical contributions, cross-domain transferability, practical implications, and limitations. Findings indicate that a systematic innovation methodology for cultural–technical contradictions must integrate educational principles, cognitive-developmental considerations, and strategies for resolving cultural constraints.

5.1. Cross-domain transferability: Theoretical analysis

The method’s theoretical foundations suggest transferability to culturally constrained domains that share analogous structural characteristics: scientifically accurate information that conflicts with cultural taboos, multiple stakeholders with incompatible acceptability standards, and content that requires progressive disclosure.

Three domains share these features and offer potential transfer candidates. Mental health education involves clinical terminology that triggers stigma comparable to sexual vocabulary; death education for children involves mortality concepts that conflict with culturally entrenched taboos; and financial literacy involves information on economic inequality that conflicts with class-based

sensitivities. Tiered content architecture, metaphor-based narrative, de-realization, and multi-stakeholder validation supply candidate strategies in each case, while sensitivity and risk thresholds calibrated for the present study would require domain-specific re-estimation. The sensitivity assessment procedure, modular architecture, and multi-stakeholder framework provide domain-independent components capable of scaling across stakeholder configurations, but these extensions derive from structural analogy rather than empirical evidence. Their confirmation depends on implementation studies in each domain, comparative effectiveness analyses, and cross-cultural replication.

5.2. Main findings and theoretical contributions

This research contributes to systematic innovation theory by demonstrating that cultural–technical contradictions constitute a distinct category requiring specialized methodological approaches. Unlike TRIZ-based methods that address physics-driven contradictions or design thinking that emphasizes empathetic exploration, the CSCD method operationalizes culturally driven subjective constraints into objective innovation parameters through algorithmic decision protocols. This challenges the assumption that cultural adaptation must remain intuitive

and context-dependent, demonstrating that systematic procedures can govern design decisions in domains previously resistant to formalization.

The method advances systematic innovation by providing algorithmic transformation of qualitative cultural judgments into quantifiable decision rules. Sensitivity-based strategy selection, cultural risk iteration, and multi-stakeholder validation are replicable procedures that reduce reliance on tacit practitioner knowledge, extending systematic innovation beyond engineering into social innovation scenarios where cultural acceptance shapes implementation feasibility alongside technical functionality.

The multi-stakeholder validation framework addresses participatory design's documented limitation: emphasis on stakeholder involvement without systematic conflict resolution when stakeholder groups maintain incompatible standards. Quantifiable acceptance thresholds, formalized iteration protocols, and explicit decision gates provide systematic procedures for managing value conflicts inherent in culturally constrained innovation. This demonstrates how systematic innovation principles, including algorithmic decision-making, quantifiable metrics, and replicable procedures, can address wicked problems characterized by subjective constraints and competing requirements, establishing theoretical foundations for extending systematic innovation methodologies into culturally sensitive domains that require balancing technical accuracy and social acceptability.

5.3. Methodological innovation and transferability

This research operationalizes cultural constraint resolution into replicable procedures with algorithmic decision protocols. Unlike frameworks that provide general principles without procedural specificity, the CSCD method establishes formalized rules that link content sensitivity to strategy selection, transforming intuitive challenges into structured processes.

The method's modular structure supports potential cross-domain applications, with empirical confirmation remaining a task discussed in Section 5.4.

5.4. Practical implications

The CSCD method offers practitioners structured approaches to cultural-technical contradictions across multiple contexts. Standalone innovation workshops provide immediate application, with facilitators guiding cross-functional teams through the five-module framework in two-day sessions to systematically resolve accuracy-acceptability tensions in product development, healthcare patient education, or public awareness campaigns. The

method integrates with existing processes, including design thinking, TRIZ, and stage-gate frameworks, by inserting Module 5 multi-stakeholder validation after ideation or prototyping, providing systematic cultural risk assessment absent in conventional approaches. Technology companies entering culturally diverse markets and publishers evaluating sensitive content can leverage these protocols to prevent costly market rejection while maintaining informational integrity.

The algorithmic protocols enable the implementation of a computer-aided innovation system. Decision algorithms governing sensitivity assessment, strategy configuration, and iteration management can be translated into decision-support software that accepts content descriptions, target demographics, and cultural parameters as inputs and generates strategy configurations and validation procedures as outputs. Future artificial intelligence (AI) integration could automate metaphor generation based on cultural databases and sensitivity patterns, extending computer-aided capabilities into culturally constrained domains.

Training applications span graduate innovation management curricula that demonstrate systematic approaches to social innovation challenges, professional development workshops on algorithmic cultural adaptation, and cross-cultural training equipping international teams with structured methodologies. The method's procedures support knowledge codification and transfer across practitioners, addressing the persistent challenge that cultural innovation expertise often remains tacit and context-specific. By providing replicable frameworks, quantifiable metrics, and algorithmic decision rules, the CSCD method transforms culturally constrained innovation from intuitive practice into a systematic discipline amenable to structured teaching, implementation, and continuous improvement.

5.5. Limitations and future research

From a systematic innovation perspective, the primary limitation concerns single-domain empirical validation. Although theoretical analysis suggests cross-domain transferability, the CSCD method has been implemented and tested only in sex education contexts. Systematic innovation methods require multi-domain validation to confirm generalizability. Decision thresholds (the 70% acceptance rate and the 10-point sensitivity scale) were derived from one cultural context and might require recalibration for other domains. Mental health, death education, and financial literacy present analogous contradictions but may demand threshold adjustments that reflect domain-specific stakeholder dynamics and constraint severities.

Algorithm validation remains limited to the research team's application during method development. The sensitivity assessment algorithm and cultural risk iteration protocol have not been tested with larger practitioner samples across diverse backgrounds and expertise levels. Systematic innovation methods gain robustness through widespread practitioner validation that demonstrates consistent results independent of implementer characteristics; current validation cannot confirm whether the algorithms produce comparable outcomes across practitioners with varying cultural backgrounds, design expertise, or domain knowledge.

Temporal validation is another constraint. The study demonstrates effectiveness during initial development and implementation but lacks longitudinal data to confirm sustained effectiveness or identify refinements through repeated application cycles. Systematic innovation frameworks typically evolve through iterative practitioner feedback and performance measurement across multiple contexts.

Future research priorities include cross-domain implementation studies applying the method to three to five different sensitive content areas with comparative effectiveness analyses; cross-cultural adaptation testing in Western, Middle Eastern, and other East Asian contexts requiring cultural parameter adjustments; longitudinal validation comparing actual implementation outcomes with predicted acceptance scores; and computer-aided development digitalizing decision protocols for testing with expanded practitioner populations. These steps would establish the method's systematic innovation credentials through demonstrated replicability, transferability, and scalability beyond the initial development context.

6. Conclusion

This study developed and validated the CSCD method, a systematic innovation framework for resolving cultural-technical contradictions in sensitive content domains. By integrating TRIZ-derived separation and inventive principles with culturally grounded design strategies, the method transforms previously intuitive cultural adaptation into replicable, algorithmic procedures. Its five interrelated modules—content architecture, pedagogical strategy, narrative design, visual representation, and multi-stakeholder validation—operate through formalized decision protocols that link content sensitivity to strategy selection and quantify cultural risk and stakeholder acceptance as designable parameters.

Empirical validation through interviews with 20 children and a seven-expert focus group in southern China demonstrated the method's applicability under extreme

cultural constraints, with sex education comics serving as the test case. The findings indicate that systematic procedures can govern design decisions in domains traditionally regarded as inherently intuitive, extending systematic innovation theory beyond engineering into culturally sensitive social innovation. The structural analogies identified further suggest transferability to other constrained domains, such as mental health, death, and financial literacy education, although such extensions remain to be confirmed empirically.

By converting tacit cultural expertise into explicit decision rules and quantifiable metrics, the CSCD method provides a replicable foundation for designing materials that require both scientific accuracy and cultural acceptance. Future research should pursue cross-domain implementation, cross-cultural calibration of sensitivity and risk thresholds, longitudinal effectiveness studies, and the digitalization of the algorithmic protocols into computer-aided innovation tools. These directions would consolidate the CSCD method's standing as a generalizable systematic innovation methodology for cultural-technical contradictions.

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Conflict of interest

The authors declare they have no competing interests.

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Ethics approval and consent to participate

This study received ethical approval from the Human Research Ethics Committee for Non-Clinical Faculties, School of Psychology, South China Normal University (Approval Number: SCNU-PSY-2024-087; Approval Date: April 3, 2024). The research was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all adult participants in the focus group discussion prior to their participation. For the child participants (aged 9–12) involved in the preliminary semi-structured interviews, written informed consent was obtained from their parents or legal guardians, and verbal assent was obtained from the children themselves before the interviews commenced.

Consent for publication

Written informed consent for the publication of anonymized research data and findings was obtained from all adult participants and from the parents or legal guardians of all child participants. No individually identifying information, photographs, or images of any participant are presented in this article.

Availability of data

The qualitative datasets generated and analyzed during this study—including interview transcripts, focus group recordings, and coded materials—are not publicly available because of the sensitive nature of the research topic and to protect participant confidentiality, in line with the conditions of the ethical approval granted for this study. De-identified and appropriately redacted excerpts may be made available from the corresponding author upon reasonable request and subject to further ethical review.

References

- Altshuller, G. (1999). *The innovation algorithm: TRIZ, systematic innovation and technical creativity*. Technical Innovation Center.
- Boer, S. (2020). 'Maybe I'll make something with it': Comics as alternative sex education. *Studies in Comics*, 11(1), 87–107. https://doi.org/10.1386/stic_00016_1
- Bramlett, F., Cook, R., & Meskin, A. (2016). *The Routledge companion to comics*. Routledge.

<https://doi.org/10.4324/9781315851334>

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.

<https://doi.org/10.1191/1478088706qp063oa>

Chen, W. (2022). Xing jiaoyu zhong guojia, fumu, ertong de xianfa guanxi—yi xing jiaoyu duben zhengyi wei li [The constitutional relationship between the state, parents, and children in sexuality education: A case study of controversies over sexuality education textbooks]. *Constitutional Law Journal*, (1), 123–135. [In Chinese]

China Children's Culture and Art Foundation, & Beijing Zhongyi Public Welfare Foundation. (2022). "Child protection" 2021 statistics on cases of child sexual abuse and survey report on children's sexual abuse prevention education. Accessed June 8, 2024. <https://all-in-one.org.cn/newsinfo/2475704.html>

China National Children's Center. (2023). *Analysis of the difficulties in implementing family sex education and policy recommendations*. Beijing, China: CNCC Press.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications.

Czerwiec, M., Williams, I., Squier, S. M., Green, M. J., Myers, K. R., & Smith, S. T. (2020). *Graphic medicine manifesto*. Penn State Press.

Dell'Era, C., Magistretti, S., Candi, M., Bianchi, M., Calabretta, G., Stigliani, I., & Verganti, R. (2025). Design thinking in action: A quantitative study of design thinking practices in innovation projects. *Journal of Knowledge Management*, 29(11), 32–58.

<https://doi.org/10.1108/JKM-04-2024-0424>

Faria, C., Valente, B., & Torres, J. (2024). Potentialities of science comics for science communication: Lessons from the classroom. *Journal of Science Communication*, 23(8), N02.

<https://doi.org/10.22323/2.23080802>

Farinella, M. (2018). The potential of comics in science communication. *Journal of Science Communication*, 17(1), 1–17.

<https://doi.org/10.22323/2.17010401>

Figueiredo, S. (2011). Building worlds for an interactive experience: Selecting, organizing, and showing worlds of information through comics. *Journal of Visual Literacy*, 30(1), 86–100.

<https://doi.org/10.1080/23796529.2011.11674686>

Green, L. W., & Kreuter, M. W. (2005). *Health program planning: An educational and ecological approach* (4th ed.). McGraw-Hill.

- Gupta, A., & Paul, T. (2014). *Menstrupedia comic: The friendly guide to periods for girls*. Menstrupedia.
- Hofstede, G. (1983). National cultures in four dimensions: A research-based theory of cultural differences among nations. *International Studies of Management & Organization*, 13(1/2), 46–74. <http://www.jstor.org/stable/40396953>
- Iqbal, M. S., & Rahman, Z. A. (2025). Accelerating high-value innovation with TRIZ patent literature review: Validation study for shape-memory polymers and smart materials. *Journal of Chemical Technology & Biotechnology*, 100(12), 2504–2511.
<https://doi.org/10.1002/jctb.7871>
- Jacquerye, A., & De Sutter, P. (2023). Sexual education, what challenges for tomorrow? In R. Sterling (Ed.), *Sexual education around the world – Past, present and future issues* (pp. 27–60). IntechOpen.
<https://doi.org/10.5772/intechopen.1001975>
- Ji, Y., & Reiss, M. J. (2022). Cherish lives? Progress and compromise in sexuality education textbooks produced in contemporary China. *Sex Education: Sexuality, Society and Learning*, 22(4), 496–519.
<https://doi.org/10.1080/14681811.2021.1955670>
- Kremer, N. T. (2017). *The comic core: A theory of teaching sequential art narratives* (Doctoral dissertation). University of Missouri-Columbia.
- Krueger, R. A., & Casey, M. A. (2015). *Focus groups: A practical guide for applied research* (5th ed.). SAGE Publications.
- Li, J., Li, Y., & Liu, W. (2022). An analysis of parents' sexual education knowledge, attitudes, and the status of family sex education. *Journal of Family Education in China*, 3(2), 45–53.
- Luz, P. K., Galindo Neto, N. M., Machado, R. S., Marques, M. C., Santos, A. M., & Andrade, E. M. (2023). Construction and validity of educational technology for adolescents on cardiac resuscitation. *Acta Paulista de Enfermagem*, 36, eAPE016932.
<https://doi.org/10.37689/acta-ape/2023AO0169332>
- Mayer, S., Roth, A., & Wollersheim, J. (2025). The impact of design thinking and its underlying theoretical mechanisms: A review of the literature. *Creativity and Innovation Management*, 34(1), 78–110.
<https://doi.org/10.1111/caim.12626>
- McCloud, S. (1993). *Understanding comics: The invisible art*. HarperPerennial.
- Mejia-Duque, J. G., & Guerrero-Alvarado, A. (2025). A TRIZ-based algorithm for business model innovation in manufacturing SMEs: A systematic framework for strategic innovation integrated with the business model canvas. *Cogent Business & Management*, 12(1).
<https://doi.org/10.1080/23311975.2025.2542427>
- Miller, S., & Bley, L. (2013). *Not your mother's meatloaf: A sex education comic book*. Soft Skull Press.
- Ministry of Education of the People's Republic of China. (2008). *Guidelines for health education in primary and secondary schools*.
- Ministry of Education of the People's Republic of China. (2021). *Guidelines for the implementation of sex education in primary and secondary schools*. Beijing, China: Ministry of Education of the People's Republic of China.
- National People's Congress of China. (2020). *Minor Protection Law*.
- Nojima, N. (2022). *My body is changing* (W. Zhang, Trans.). Sichuan Literature and Art Publishing House. (Original work published 2018)
- Preston, J., & Thomassen, A. (2010). Writing through design, an active practice. *Journal of Writing in Creative Practice*, 3(1), 45–62.
https://doi.org/10.1386/jwpc.3.1.45_1
- Rösch, N., Tiberius, V., & Kraus, S. (2023). Design thinking for innovation: Context factors, process, and outcomes. *European Journal of Innovation Management*, 26(7), 160–176.
<https://doi.org/10.1108/EJIM-03-2022-0164>
- Shimizu, A. (2015). *Cells at Work!* (Vol. 1). Kodansha.
- Sorcar, P. (2009). *Teaching taboo topics without talking about them: An epistemic study of a new approach to HIV/AIDS prevention education in India*. Doctoral dissertation. Stanford University.
- Sorcar, P., Strauber, B., Loyalka, P., Kumar, N., & Goldman, S. (2017). Sidestepping the elephant in the classroom: Using culturally localized technology to teach around taboos. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 2792–2804). ACM.
<https://doi.org/10.1145/3025453.3025958>
- Stewart, D. W., & Shamdasani, P. (2017). Online focus groups. *Journal of Advertising*, 46(1), 48–60.
<https://doi.org/10.1080/00913367.2016.1252288>
- Sutton, J. (2019, February 7). 50 comics about science from a non-scientist. *Bored Panda*. Accessed June 8, 2024. <https://www.boredpanda.com/comics-about-science-john-sutton/>
- Tavares, R., Alemany-Pagès, M., Araújo, S., Cohn, N., Ramalho-Santos, J., & Azul, A. M. (2023). Comics in science and health communication: Insights from mutual collaboration and framing a research practice. *International Journal of Qualitative Methods*, 22, 1–21.
<https://doi.org/10.1177/16094069231183118>
- TeachAids. (n.d.). *Prevention begins with me*. Retrieved

October 15, 2025, from <https://teachaids.org/for-hiv-aids/prevention-begins-with-me/>

UNESCO. (2018). *International technical guidance on sexuality education: An evidence-informed approach*. United Nations Educational, Scientific and Cultural Organization.

<https://doi.org/10.54675/UQRM6395>

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2021). *The journey towards comprehensive sexuality education: Global status report*. <https://www.unesco.org/en/articles/journey-towards-comprehensive-sexuality-education-global-status-report>

Wacnik, P., Daly, S. R., & Verma, A. (2025). Participatory design: A systematic review and insights for future practice. *Design Science*, 11, e21.

<https://doi.org/10.1017/dsj.2025.10009>

Winarto, W., Khiyarusoleh, U., Ardiyansyah, A., Wilujeng, I., & Sukardiyono. (2018). Pocket book based on comic to improve conceptual understanding of child sex abuse (CSA): A case study of elementary school. *International Journal of Instruction*, 11(4), 889–900.

<https://doi.org/10.12973/iji.2018.11456a>

Wiseman, R., Collver, J., Worth, R., & Watt, C. (2021). Hocus pocus: Using comics to promote skepticism about the paranormal. *Journal of Science Communication*, 20(2), 1–16.

<https://doi.org/10.22323/2.20020204>

World Health Organization (WHO). (2023, May 18). *Comprehensive sexuality education*. <https://www.who.int/news-room/questions-and-answers/item/comprehensive-sexuality-education>

Zheng, X., & Chen, G. (2010). Zhongguo qingshaonian shengzhi jiankang ke jixing diaocha jichu shuju baogao [Basic data report of the accessibility survey on reproductive health for Chinese adolescents]. Institute of Population Research, Peking University. [In Chinese].

<https://doi.org/10.3969/j.issn.1674-1668.2010.03.001>

Zhou, Y. (2024). Unpacking the problems of sex education in Chinese primary and secondary schools and the improvement measures. *Journal of Education, Humanities and Social Sciences*, 45, 559–566.

<https://doi.org/10.54097/56qpjg93>