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# Co-making the future: judges' insights on transdisciplinary creativity and global collaboration in the China-U.S. young maker competition

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This paper examines the future of maker education through an analysis of feedback from judges in the China-U.S. Young Maker Competition. Drawing on inputs from 36 judges from diverse backgrounds in academia, industry, and sponsoring companies, the study uses thematic analysis of interviews, feedback, and focus group discussions to uncover key educational trends. It highlights critical themes such as transdisciplinary creativity, real-world application, sustainability, cross-cultural collaboration, and innovation mindset. The research reveals a trend towards integrating various academic fields to boost creative problem-solving and application in real-life scenarios. Sustainability is identified as a crucial component, pointing to the need for environmentally aware education. The study also emphasizes the importance of cross-cultural collaboration for global interconnectedness and adaptive problem-solving, alongside fostering a continuous innovation mindset in students. Concluding with future directions for maker education, the paper advocates for an experiential, inclusive, and forward-looking educational approach. It underscores the importance of a broad curriculum that integrates entrepreneurial skills, promotes lifelong learning, and enhances global connectivity. This study provides insights for educators, policymakers, and practitioners, offering a streamlined roadmap for advancing maker education in a rapidly evolving global context.

KEYWORDS

**maker education, thematic analysis, cross-cultural perspectives, transdisciplinary creativity, China-U.S. collaboration**

## 1 Introduction

In our current era, marked by a wave of open innovation often described as "mass entrepreneurship and innovation," we are seeing significant changes in our society. This change is fueled by a burst of creative thinking and problem-solving (Basadur and Hausdorf, 1996; Asheim et al., 2007; Chatterji et al., 2014; Clapp et al., 2016; Hepp, 2020). At the heart of this

change is the "maker" movement, a blend of open innovation principles that has created a lively and interactive community. This movement is about two main things: a strong love for technology and a commitment to making innovative ideas come to life (Martinez and Stager, 2013; Halverson and Sheridan, 2014; Kolb et al., 2014; Lindtner, 2015). The maker movement, which started in the do-it-yourself (DIY) and hacker cultures of Europe and America, has now become well-known worldwide. It is known for encouraging innovation, sharing openly, being involved hands-on, and always looking to improve the quality of life. Events like the Maker Faire have become symbols of this movement, attracting support from both governments and communities (Tabarés and Boni, 2023). In China, the DIY culture has been popular since the 1980s and has grown to include activities like making custom furniture and assembling personal computers, showing a dedication to creative and practical work (Lazonick, 2004; Williamson, 2016; Wen et al., 2022).

In this setting, the China-U.S. Young Maker Competition stands out as an important event. It is more than just a competition; it is a place where creative minds come together to solve big global problems, like environmental sustainability and climate change, with their inventive ideas. It is a mix of different ideas and cultures and has been a place for fostering innovation and developing talent for over a decade.

This paper takes a close look at this period of vibrant innovation and the maker culture. Instead of focusing on the participants, as many studies do, we turn our attention to the judges of the China-U.S. Young Maker Competition. This new focus is intended to give us a better understanding of how the maker movement affects education and has a wider impact on society. We use a qualitative thematic analysis to look closely at the data collected from the judges of the competition. This approach lets us explore their viewpoints in depth, giving us a better understanding of what happens in the competition. This method is different from most of the research done before, which usually focuses on what the participants experience. With this study, we aim to answer an important question: How do the judges' views in the China-U.S. Young Maker Competition show and shape the current trends in maker education and its overall effect on society? This question is at the heart of our study, as we look to uncover deeper insights into how innovation, education, and cultural exchange interact in this unique international competition.

# 2 Related works

## 2.1 Deepening creativity and innovation in maker education

The maker movement's integration into educational systems represents a transformative shift, redefining learning by nurturing creativity and innovation (Weng et al., 2022). This movement, emerging from DIY and hacker cultures, challenges the traditional educational framework by promoting active, hands-on learning and creative problem-solving. It enables students to evolve from passive learners to active creators, integrating diverse disciplines from arts, science, and technology (Dym et al., 2005). This transdisciplinary approach not only enhances creative thinking but also fosters essential problem-solving skills, addressing the needs of today's rapidly changing world.

Educational competitions within the maker movement serve as powerful catalysts for this transformation (Liu et al., 2021). They provide real-world challenges that inspire students to apply their theoretical knowledge in practical contexts, thereby promoting a culture of inventive thinking and collaborative problem-solving. These competitions are more than just contests; they are platforms where students can showcase their technical skills and creative prowess. They motivate students to break free from conventional thought processes and explore innovative possibilities. This encourages the cultivation of a generation of innovators who are not only technically proficient but also creatively confident.

The maker movement, particularly through these competitions, plays a crucial role in shaping future innovators. These events challenge students to create and innovate, pushing them to develop solutions that are both imaginative and technically sound (Miettinen, 2000). They inspire a spirit of exploration and discovery, essential for fostering a culture of continuous learning and adaptation. As students engage in these competitions, they learn to navigate complex problems, work collaboratively, and think critically, preparing them for the challenges of the modern world (Martin, 2015; Chakraborty et al., 2023; Tablatin et al., 2023). The maker movement encourages inclusivity and diversity in problem-solving approaches. By bringing together students with varied backgrounds and skill sets, it fosters an environment where different perspectives are valued and explored. This diversity is critical in driving innovation, as it leads to a richer pool of ideas and solutions. As such, the maker movement and its associated competitions are pivotal in developing well-rounded individuals who are equipped to contribute to and thrive in a world that values creativity and innovation.

## 2.2 Enhancing a comprehensive approach in educational competitions

Incorporating Human-Centered Design (HCD), Human-Computer Interaction (HCI), and User eXperience (UX) design within maker education exemplifies a multidimensional approach that focuses on fostering innovation, empathy, and responsibility (Ren et al., 2019; Al Mahmud and Soysa, 2020; Yang et al., 2022; Liu et al., 2023; Zhu et al., 2024). HCD in maker education extends beyond the creation of functional solutions; it's about crafting projects that are impactful and prioritize human needs and experiences. This perspective encourages students to think from the end-user's viewpoint, leading to designs that are not only effective but also empathetic and meaningful. HCI and UX design play a crucial role in this educational paradigm. These disciplines ensure that technology is not merely technically advanced but also accessible and engaging. They prompt students to consider how users interact with technology, emphasizing the importance of intuitive design and meaningful user experiences. Such an approach is essential in preparing students to develop technology that is not just functional but enjoyable and efficient to use. The integration of these principles in maker education and competitions represents a shift towards a more holistic view of technological development. It encourages students to create solutions that consider the broader context of their use, including accessibility, usability, and practicality. This approach is vital in nurturing a generation of innovators who are adept at balancing technical proficiency with thoughtful, user-centered design.

In educational competitions, this comprehensive approach influences how projects are developed and evaluated. The focus extends beyond technical skill to encompass how well projects align with principles of HCD and technological intuitiveness. It instills in students a deeper understanding of the importance of creating solutions that are not only innovative but also considerate of the users' needs and experiences (Desmet et al., 2023; Lachheb et al., 2023). Ultimately, this approach in maker education cultivates a sense of responsibility among students towards creating more inclusive and user-friendly technology. It prepares them to become creators who are not only technically skilled but also mindful of the human aspect of technological innovation. They learn to create solutions that are not just effective but also enrich users' lives, setting a new standard for how technology is designed and utilized.

### 2.3 Expanding the role of the competition in global innovation and sustainability

Since its inception in 2014, the China-U.S. Young Maker Competition has grown into a significant platform for fostering cross-cultural innovation and collaboration. With its impressive participation—over 50,000 individuals contributing to more than 14,000 projects—it has become a major driver of innovation in numerous cities and universities in both countries. This competition is not only a testament to the creativity and technical skills of its participants but also a reflection of the growing importance of global collaboration in education and innovation.

The competition's alignment with the United Nations Sustainable Development Goals (UN SDGs) underscores its commitment to contributing to global challenges through creative and sustainable innovation (Carlsen and Bruggemann, 2022; Lafont-Torio et al., 2024). By incorporating these goals, the competition encourages participants to develop projects that are not only technologically advanced and creatively rich but also address important issues like climate change, sustainable urban development, and responsible consumption. This focus on the UN SDGs elevates the competition from being merely a technical showcase to a platform for meaningful global impact.

The diverse range of projects that emerge from this competition highlights the potential of young innovators to contribute to sustainable solutions for the world's most pressing problems. From addressing environmental concerns to promoting social equity, the projects align with various SDGs, showcasing the competition's role in driving forward these crucial global agendas. The competition serves as an important model for how educational initiatives can integrate creativity, technology, and sustainability. It demonstrates the value of fostering a mindset among young innovators that prioritizes not just technical proficiency but also a deep understanding of the broader societal and environmental implications of their creations.

## 3 Methodology and data analysis

### 3.1 Approach to qualitative inquiry

A qualitative research methodology was employed to explore the perspectives of judges in the competition (Sanders and Stappers, 2012; de Bont, 2021). This approach was chosen for its effectiveness in capturing detailed insights into judges' experiences, decision-making processes, and evaluative criteria. The qualitative method allowed for an in-depth exploration of judges' viewpoints on creativity, innovation, and the criteria they applied within the competition. The flexibility inherent in qualitative research enabled adjustments and refinements in our approach as new themes and insights emerged, ensuring a dynamic and comprehensive inquiry process.

### 3.2 Engagement and data gathering

In this research, our focus was on data collection and analysis, distinctly separate from the roles of judges or mentors within the competition. By adopting a non-participatory, analytical stance, we were able to ensure an objective approach to data collection, which was essential for accurately capturing and interpreting the judges' perspectives. This methodology allowed us to gather data while maintaining the integrity and authenticity of the judges' experiences and viewpoints.

The data collection process was meticulously organized to encompass a broad spectrum of perspectives from the judges, who hailed from varied professional backgrounds. The judging panel consisted of 36 individuals: 24 from the academic sector, 8 from industry, and 4 representing the sponsor companies of the competition. Their areas of expertise covered a wide range, including computer sciences, creative industry, entrepreneurship, and industrial design, thus offering a rich and comprehensive collection of professional insights. Additionally, the judges' average age of 45.18 years brought together a mix of seasoned experience and contemporary perspectives, further enriching the data collected for our analysis.

- Interviews: in-depth interviews with the judges, conducted in both structured and semi-structured formats, were instrumental in gathering detailed insights into their assessment criteria, the challenges they encountered, and their viewpoints on the projects evaluated. The varied professional backgrounds of the judges, encompassing areas like computer sciences and the creative industry, offered a multifaceted understanding of the competition's evaluation process.
- Judging criteria and feedback reviews: an extensive analysis of the judging criteria and written feedback from the judges resulted in over 50 pages of detailed notes and reflections. This part of the data collection was key in deciphering the various criteria and considerations used by judges from different fields such as entrepreneurship and industrial design in their evaluations.
- Focus group discussions: organizing focus group discussions with the judges allowed for an in-depth exploration of their collective experiences and viewpoints. These discussions, enriched by the judges' diverse professional backgrounds, provided deeper insights into their consensus and differing opinions. We collected extensive transcripts from these focus groups, totaling over 30,000 words. This substantial dataset offered a thorough understanding of the judges' collective thought processes, decision-making, and the dynamics of their evaluations.

### 3.3 Analysis of qualitative data

The analysis process involved a structured thematic approach to describe the collected data (Braun and Clarke, 2023):

- Initial coding and organization: the data from interviews, feedback reviews, and focus group discussions were initially categorized into broad thematic areas to facilitate organization and analysis.
- Refined theme development: further examination of these initial codes led to the identification of refined themes, revealing deeper insights into judges' perspectives on creativity, innovation, and their evaluative processes within the competition.
- Narrative construction and synthesis: the final stage involved constructing a coherent narrative that integrated these themes, providing a comprehensive portrayal of the judges' roles and impacts on the competition.

This methodology and analysis approach provided a thorough and detailed understanding of the judges' perspectives in the competition. The qualitative analysis was pivotal in uncovering significant insights into the judges' contributions to fostering an environment of cross-cultural innovation and understanding in this notable educational event.

## 4 Findings and discussion

The thematic analysis represented in Table 1 serves as the bedrock for the findings detailed in sections 4.1 through 4.6. Initiated with an exhaustive examination of various data sources, including structured interviews with judges, feedback forms, and focus group discussions, each source contributed indispensable insights integral to comprehensively understanding the impact of the maker competition. For instance, the theme 'Embracing Transdisciplinary Creativity' discussed in section 4.1 was principally derived from the data obtained through judges' interviews. These interviews provided rich qualitative insights, particularly highlighting the judges' appreciation for the integration of different disciplines in project development. The feedback forms complemented this theme, offering concrete examples of the judges' focus on cross-disciplinary skills and artistic expression. In similar fashion, sections 4.2 through 4.6 explore themes such as 'Prioritizing Practical Application and Real-World Impact' and 'Nurturing Global Awareness Through Sustainability'. These themes were significantly informed by focus group discussions, which revealed depth in perspectives concerning the importance of real-world applications, sustainability practices, and the value of cross-cultural collaboration in the projects.

The analytical approach in this study extended beyond simple data gathering. It involved a thorough process of organizing and interpreting the data to ensure it was relevant and well-supported by strong evidence. This careful process was crucial in creating a narrative that is both engaging and solidly based on empirical data. By clearly showing the sources of our data and including a wide range of perspectives, we sought to strengthen the credibility and trustworthiness of our findings. The resulting narrative is not only complete but also reflects the comprehensive and varied nature of our data analysis. The table does more than just list themes; it demonstrates the detailed analytical process we undertook. It illustrates how each level of coding, from the first to the third, is linked to specific data sources, thus providing a thorough view of the judges' perspectives. This organized approach ensures that our findings are supported by a wide array of data, from direct quotes in interviews to shared insights from focus group discussions. Therefore, the table serves as evidence of the thoroughness and depth of our analysis, highlighting the careful thought and scrutiny that support the conclusions of our study.

### 4.1 Embracing transdisciplinary creativity

In the rapidly evolving educational sector, the judges' emphasis on transdisciplinary creativity in the competition is a guiding light for future educational trends. This approach underscores the necessity of integrating various disciplines, such as arts, science, and technology, to cultivate a more holistic understanding and application of knowledge. This blend enriches students' learning experiences, equipping them with a broader skill set and fostering a mindset that transcends conventional academic boundaries. A judge eloquently stated, "Blending disciplines in maker projects leads to more comprehensive and creative solutions, bridging the gap between theory and practical application." This philosophy underscores the imperative to prepare students for the complexities of the modern world, where problems often require multifaceted solutions that draw on a range of disciplines. By embracing this transdisciplinary approach, maker education can become a powerful tool for nurturing versatile, innovative thinkers capable of addressing contemporary challenges with creativity and depth.

- Integrate diverse disciplines: advocate for the inclusion of diverse subjects in maker education, promoting projects that combine arts, science, and technology.
- Foster creative problem-solving: encourage educational programs that emphasize creative thinking and innovative problem-solving approaches.
- Nurture versatile skill sets: develop curriculum structures that build versatile skills, preparing students for multidisciplinary challenges.

### 4.2 Prioritizing practical application and real-world impact

Judges' feedback from the competition highlighted the critical role of practical application and real-world impact in projects, signaling a transformative shift in maker education towards applied learning. This focus is crucial for bridging the gap between academic theories and their practical applications in the real world, fostering a learning environment where students can see the direct impact of their innovations. As one judge aptly put it, "Projects that solve real-world problems not only demonstrate students' technical skills but also their understanding of societal needs." This insight is invaluable for educational institutions aiming to equip students with skills that extend beyond the classroom, ensuring that their learning experiences are directly relevant to real-world scenarios. By prioritizing projects with practical applications and societal

TABLE 1 The thematic analysis coding.

| Themes (sections) | First-level code | Second-level code | Third-level code | Data source |
|---|---|---|---|---|
| 4.1 Embracing transdisciplinary creativity | Integration of disciplines | Arts integration | Conceptual understanding | Feedback |
| | | | Transdisciplinary skills | Discussion |
| | | | Artistic expression | Interview |
| | | Technology utilization | Creative technological solutions | Interview |
| | | | Technological proficiency | Feedback |
| | | | Innovative tech application | Discussion |
| 4.2 Prioritizing practical application and real-world impact | Practical solutions | Addressing societal challenges | Real-world relevance | Interview |
| | | | Societal impact | Feedback |
| | | | Practical problem solving | Discussion |
| | | Solution feasibility | Implementation viability | Interview |
| | | | User-oriented design | Discussion |
| | | | Solution sustainability | Discussion |
| 4.3 Nurturing global awareness through sustainability | Environmental impact | Sustainable design principles | Environmental conservation | Discussion |
| | | | Sustainable practices | Interview |
| | | | Eco-friendly solutions | Feedback |
| | | Global responsibility | Global impact | Discussion |
| | | | Ethical and responsible design | Interview |
| | | | Addressing global challenges | Discussion |
| 4.4 Fostering cross-cultural collaboration and understanding | Cultural diversity | Teamwork across cultures | Diversity of perspectives | Feedback |
| | | | Effective communication | Interview |
| | | | Cultural exchange and learning | Interview |
| | | Global relevance | Cultural sensitivity | Discussion |
| | | | Global innovation | Feedback |
| | | | Adapting to diverse viewpoints | Discussion |
| 4.5 Encouraging adaptive problem-solving | Flexibility and resilience | Dynamic solution building | Responsiveness to challenges | Feedback |
| | | | Flexible thinking | Discussion |
| | | | Adapting to changing needs | Discussion |
| | | Problem-solving strategies | Overcoming obstacles | Interview |
| | | | Innovative solutions | Feedback |
| | | | Creative problem-solving Approaches | Interview |
| 4.6 Long-term impact on innovation mindset | Innovation mindset | Continuous learning | Lifelong learning | Feedback |
| | | | Curiosity and exploration | Discussion |
| | | | Embracing new knowledge | Interview |
| | | Lifelong innovation | Risk-taking and experimentation | Discussion |
| | | | Adaptability in innovation | Discussion |
| | | | Persistent creative development | Interview |

impacts, maker education can play a pivotal role in developing solutions to pressing global challenges, ultimately fostering a generation of students who are not just knowledgeable but also socially responsible and impact-driven.

- Promote real-world applications: emphasize the development of projects that address real-world challenges and societal needs.
- Bridge academic learning and practical impact: align maker education with practical applications, ensuring students' projects have tangible impacts.
- Cultivate solution-oriented mindsets: encourage an educational approach that nurtures solution-oriented thinking in students.

## 4.3 Nurturing global awareness through sustainability

The theme of sustainability in the judges' evaluations highlights the growing importance of global awareness and responsibility in

maker education. Judges emphasized the need for projects to incorporate sustainable practices and consider their environmental impacts, aligning with the global movement towards more sustainable development. "Sustainable projects in maker education not only address environmental concerns but also teach students the importance of responsible innovation," one judge noted. This perspective is crucial in today's context, where environmental challenges require innovative solutions that are both effective and sustainable. By fostering a focus on sustainability in maker education, educators can prepare students to be conscientious global citizens who understand the importance of their impact on the world. This approach goes beyond traditional education, fostering a deeper sense of responsibility and ethical innovation in the next generation of makers.

- Incorporate sustainable practices: integrate sustainability into maker projects, teaching students to design with environmental consciousness.
- Teach global responsibility: educate students on the global impact of their projects, fostering a sense of ethical responsibility.
- Promote eco-friendly innovation: encourage the development of projects that are not only innovative but also beneficial to the environment.

## 4.4 Fostering cross-cultural collaboration and understanding

The judges' recognition of the value of cross-cultural collaboration in the competition underscores the necessity of preparing students for a globally interconnected world. Teams that harnessed diverse cultural perspectives were often able to produce more innovative and relevant solutions, illustrating the richness that diversity brings to problem-solving. A judge commented, "Diversity in teams brings a wealth of perspectives that often lead to more innovative outcomes." This insight stresses the importance of integrating cross-cultural collaboration in maker education, not only to enhance the creativity and scope of projects but also to foster understanding and respect among students from different cultural backgrounds. By promoting projects that encourage cultural exchange and global relevance, maker education can cultivate an environment that respects diversity, encourages inclusivity, and prepares students to operate effectively in a global context.

- Encourage cultural exchange: promote projects that bring together students from diverse cultural backgrounds, enhancing the richness of collaboration.
- Teach global relevance: ensure maker education includes a focus on developing globally relevant solutions.
- Nurture diverse perspectives: cultivate an educational environment that values and incorporates a variety of cultural viewpoints.

## 4.5 Encouraging adaptive problem-solving

The judges' appreciation for adaptive problem-solving skills in the competition highlights a critical skill set for the future of maker education. Their feedback emphasizes the importance of flexibility, resilience, and the ability to adapt solutions to new challenges or feedback. As one judge put it, "The ability to adapt and refine solutions is as important as the initial innovation." This perspective is particularly relevant in the rapidly changing modern world, where problems and technologies evolve quickly. By teaching students to be adaptable and responsive in their problem-solving approaches, maker education can foster a generation of innovators who are not only skilled but also agile and capable of navigating the complexities and uncertainties of the future.

- Develop flexible thinking: foster educational programs that emphasize adaptability and flexibility in problem-solving.
- Promote innovative solutions: encourage students to think innovatively and be open to evolving their projects.
- Teach resilience in design: incorporate resilience as a key component in maker education, preparing students to tackle unforeseen challenges.

## 4.6 Long-term impact on innovation mindset

The judges' insights reveal the significant role of maker competitions in cultivating a long-term mindset of innovation among participants. This aspect is crucial for sustaining a culture of creativity and exploration in maker education. A judge observed, "Fostering an enduring innovation mindset is crucial for the continuous evolution of ideas." This perspective highlights the need for maker education to go beyond temporary projects and foster a lasting focus on innovation. By encouraging continuous learning, exploration, and creative confidence, maker education can inspire students to pursue innovative endeavors throughout their lives, driving forward a culture of innovation and creative problem-solving.

- Foster continuous innovation: advocate for educational approaches that nurture a lasting focus on creativity and innovation.
- Encourage lifelong learning: promote opportunities for continuous learning and exploration beyond formal education.
- Inspire creative confidence: build programs that foster confidence in students to pursue creative and innovative endeavors.

# 5 Conclusions and future directions

The analysis of judges' feedback from the China-U.S. Young Maker Competition highlights key aspects for the evolution of maker education. Emphasis on transdisciplinary creativity, practical applications, sustainability, cross-cultural collaboration, adaptive problem-solving, and a long-term innovation mindset shapes the future of this educational approach. These insights offer a condensed roadmap for advancing maker education, highlighting the need for a comprehensive, experiential, and globally aware approach to equip students for future challenges. The findings

point towards an educational shift to transdisciplinary creativity, integrating various disciplines to enhance problem-solving skills. The focus on practical applications with real-world impact reflects a move towards experiential learning that addresses societal challenges. Sustainability emerges as a crucial theme, aligning with global environmental consciousness. Cross-cultural collaboration is identified as key in preparing students for a globally interconnected world. Adaptive problem-solving is crucial for developing flexible and innovative thinkers. The study also highlights the importance of competitions in fostering a long-term innovation mindset, encouraging ongoing creativity and exploration.

Future directions include integrating maker education across various educational levels and disciplines, focusing on hands-on, real-world problem-solving. Incorporating entrepreneurship and business education within maker programs can bridge the gap between innovation and practical application. Promoting lifelong learning and innovation beyond formal education is essential for continuous skill development. Enhancing global connectivity and responsiveness to technological changes ensures that maker education remains relevant and forward-thinking. Continued research into the effectiveness and long-term impact of maker education will provide insights for its optimization.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by Beijing Normal University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

WL: Conceptualization, Methodology, Writing – original draft. YZ: Formal analysis, Writing – review & editing. YiL: Conceptualization, Writing – original draft. ZF: Methodology, Writing – review & editing. YS: Writing – review & editing. XH: Formal analysis, Writing – original draft. YaL: Formal analysis, Writing – original draft. ML: Methodology, Supervision, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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