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Imagining curiosity-driven science and ethics from the perspective of future generations: A Future Design case study

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Abstract

Future Design (FD) is a participatory approach that invites people to adopt the perspective of imaginary future generations in order to reconsider present choices and long-term societal challenges. This study examines how such perspective-taking shapes interdisciplinary researchers' reflections on the future relationship between curiosity-driven science, technological change, and ethical responsibility. As part of the Tsukuba Conference 2023, eight early- and middle-career researchers from diverse disciplinary and geographical backgrounds participated in two three-hour online workshops and a subsequent in-person plenary discussion. Participants acted as "time travelers" from 2053 and collaboratively wrote letters to people living in 2023. The resulting narratives revealed both convergent and contrasting future imaginaries. Both groups anticipated the pervasive integration of artificial intelligence into everyday life and science, while differing in their expectations regarding individualism, community, and empathy. Discussions further highlighted the changing meanings of human identity, the role of historical consciousness in future imagination, persistent concerns about inequality and marginalization, and the evolving nature of ethical norms. The findings suggest that the value of FD lies less in producing consensus or prediction than in enabling pluralistic reflection on uncertainty, intergenerational responsibility, and contested futures. The study contributes to participatory futures research by demonstrating how future-generation role-playing can support interdisciplinary ethical reflection on science and technology while also revealing limitations concerning representation, inclusiveness, and methodological interpretation.

1. Introduction

Science has conventionally been driven by curiosity (Ball, 2013). However, contemporary global issues, such as global warming, atmospheric and ocean pollution, infectious diseases, poverty, war, and conflicts, have underscored issues-based science (Lin et al., 2023). In parallel, new technologies, represented by artificial intelligence (AI) and genetic modification, have been developing at an accelerated pace. This situation increases volatility, uncertainty, complexity, and ambiguity (VUCA; Bernett & Lemonie, 2014; Taskan et al., 2022), particularly in envisioning future societies. In such a VUCA situation, the role of scientists should not be limited to purely scientific activities, but also extended to ethical, legal, and social issues (ELSI; Gilbert, 2005) because they produce novel scientific knowledge and technologies. Therefore, it is time to rethink the role of scientists, particularly early-career experts.

Based on this understanding, the authors organized a plenary session titled "Future Design by Future Shapers" at the Tsukuba Conference in 2023. According to the conference organizer, the "Tsukuba Conference is a biannual international conference where talented young people from industry, government, and academia from around the world gather in Tsukuba Science City [as future shapers] to discuss various issues in 'science and technology in society' to form networks among them (Tsukuba Conference Organizing Council, 2019)."

The international society had experienced the COVID-19 pandemic since late 2019. As of 2023, the transition to a post-COVID-19 society and human security were recognized as urgent agenda items. For instance, the pandemic may have accelerated the fragmentation of communities worldwide (Cornelson & Miloucheva, 2020). Moreover, the war in Ukraine, along with other conflicts and security issues, underscored the importance of human security. In addition, AI technology, exemplified by ChatGPT, was advancing rapidly and being widely utilized.

In accordance with this recognition, the session was designed to discuss how the world would change over the upcoming three decades and what kind of intellectual curiosity and ethical responsibility future generations might value in shaping science and society. Rather than treating these future visions as predictions, we use them as empirical material for examining how the perspective of imaginary future generations influences interdisciplinary reflection on science, technology, and ethics.

Accordingly, this paper presents the methodology and outcomes of the plenary session and discusses the future direction of science and technology from the multifaceted viewpoints of early-career experts to address the following research question: How does adopting the perspective of imaginary future generations shape interdisciplinary researchers' reflections on the future relationship between curiosity-driven science, technological change, and ethical responsibility? By addressing this question, this study contributes to participatory futures research by demonstrating how such an approach can facilitate interdisciplinary reflection on curiosity-driven sciences, technology, and scientific ethics.

2. Methodology

2.1. The Future Design Approach

To envision the state of science and technology in 50 years, we applied the Future Design (FD) approach. According to Saijo's original definition (Saijo, 2020), FD refers to "a movement that studies the types of social systems that would ensure sustainable environments and societies for future generations." It designs and implements social systems that activate *futurability*, or a human trait "where people experience an increase in happiness because of deciding and acting to forgo current benefits in order to enrich future generations (Saijo, 2019, 2020)," to control vicious cycles. An individual exhibits *futurability* when they experience an increase in happiness as a result of deciding and acting to forgo current benefits, provided that doing so enriches future generations (Saijo, 2020). FD workshops bring together an imaginary future generation to backcast current global issues, such as the pandemic, human conflicts and security, insufficient progress on the Sustainable Development Goals, and the rapid development of artificial intelligence.

In practice, FD is understood as a systematic approach for citizens and policymakers to develop future-oriented policies (MacAskill, 2022), functioning as a mechanism to counter "presentism" by activating the inherent human desire to care for future generations (Saijo, 2020). It can be regarded as a practice of

envisioning a future by stimulating present consciousness to represent the voices of future generations and facilitating a societal transition toward that vision (Nakagawa, 2024).

In participatory settings where stakeholders co-create regional or organizational visions, FD is typically operationalized by having participants adopt the perspective of imaginary future generations (Kamijo et al., 2017). Empirical evidence for the effectiveness of this deliberative framework has become increasingly robust, with consistent results confirmed across a wide array of policy domains. Numerous experimental and field-based studies have repeatedly demonstrated that this future-oriented perspective significantly shifts participant preferences away from the status quo toward more sustainable, albeit often more burdensome, policy options (Nakagawa et al., 2019; Pandit et al., 2021). These findings indicate a high degree of replicability, showing that the FD intervention effectively mitigates the conflict between immediate interests and long-term societal goals by restructuring the deliberative environment.

Beyond these quantitative outcomes, research has increasingly focused on the cognitive and psychological mechanisms underlying the FD effect. Qualitative analyses have elucidated how this specific deliberative setting stimulates participants' creativity and insight, enhancing their problem-solving capabilities, allowing for the emergence of novel solutions that are often overlooked in traditional present-focused discussions (Nakagawa, 2020). Furthermore, there is growing evidence that these effects operate at a metacognitive level, potentially fostering lasting shifts in individuals' intergenerational responsibility and their capacity for long-term thinking (Nakagawa & Saijo, 2020). By engaging in this role-playing process, participants do more than simply simulate a role; they immerse themselves in an evolving narrative of transition. This immersion enables them to bridge the presentist gap and internalize the necessity of systemic change, transforming the abstract concept of sustainability into concrete, lived experience of intergenerational stewardship.

The adoption of FD for this session was essential to overcome the presentist biases inherent in conventional scientific forecasting. By positioning early-career experts as "time travelers" from 2053, the methodology allowed them to transcend current professional identities and backcast complex global crises such as AI development and geopolitical conflicts. This radical shift in perspective facilitated a normative exploration of future ethics and intellectual curiosity, enabling participants to navigate the tensions between utopian and dystopian visions from the grounded perspective of those who will inhabit that future.

2.2. Workshop Design

The authors acted as panelists of the Future Shapers session. The panelists consist of eight early- and mid-career scientists from archaeology, environmental engineering, history, informatics, midwifery, philosophy, psychology, public health, space technology, and sustainable development from Asia, Africa, Europe, and North America (in alphabetical order). The speakers were divided into two groups in consideration of expertized fields, gender, and region. The session comprised small-group discussion in preliminary workshops and the following plenary panel discussion to discuss how the world will have

changed by 2050 and what kind of intellectual curiosity and sense of ethics young people of the future will value and use to influence the world, guided by the following key questions:

1. How will the world have changed in 50 years by 2053?
2. What kind of intellectual curiosity and sense of ethics will the future generations in 2053 value and use to influence the world?

2.2.1. Breakout Preliminary Workshops

Prior to the plenary panel discussion, each group had a three-hour online workshop on the key questions in July 2023. According to the FD approach, panelists acted as time travelers in 2053, representing an imaginary future generation, and prepared a one-page letter from the time travelers to people in 2023 (see Boxes 1 and 2). Each workshop progressed in the following sequence:

1. Opening Remarks: The workshop began with short opening remarks, setting the stage for the activities and discussions to follow. This introduction provided participants with an overview of the workshop's objectives, emphasizing the importance of reflecting on historical trajectories, current challenges, and future aspirations in science and technology.

2. Icebreaker (15 minutes): Following the opening remarks, as an icebreaker to foster a relaxed and interactive atmosphere, the participants were invited to share their personal journeys as researchers, based on the following two guiding questions:

- What curiosity led you to embark on a career as a researcher?
- What social background contributed to the development of your curiosity?

The responses aimed to reveal the diverse motivations and contextual influences that have shaped participants' professional paths. This sub-session concluded with a group discussion on what society was like when you began your journey as researchers.

3. Past Design (25 minutes): Building upon insights from the icebreaker, the participants were encouraged to reflect on societal changes over the past three decades. The participants collaborated to describe the world of 2023 from the viewpoint of individuals from 30 years ago. The discussion was framed around two key aspects:

- Providing a holistic understanding of the current state of the world.
- Sending messages to the past, which may include expressions of appreciation, criticism, or advice.

This retrospective exercise allowed the participants to critically assess the interplay between historical trends and contemporary realities.

4. Future Design (75 minutes): Following the Past Design session, an FD session was held as the main session of the workshop, envisioning the year 2053. Participants were invited to engage in a speculative exercise in which they imagined having traveled to 2053 and reflecting on 2023. The following two primary discussion points guide this session:

- Describing what the world of 2053 is like, with references to scientific, technological, and societal developments.
- Reflecting on how their lives are shaped in this imagined future.

To ground the discussion, participants were also encouraged to incorporate the following keywords:

- **Curiosity**, a driving force behind scientific and technological advancements.
- **Ethics**, addressing the responsibilities of those involved in developing science and technology.

Example topics included the relationship between humans and the imaginary world in the post-pandemic era, the connection between war and digital transformation, and ethical concerns surrounding generative AI.

5. Reflective Discussion (45 minutes): Following the future-oriented exercise, the participants engaged in a reflective discussion to synthesize insights from previous sessions. This segment aimed to bridge the temporal perspectives explored in the workshop––linking the past, present, and future. The participants were encouraged to share their thoughts on actionable steps that can shape a desirable future.

6. Closing Remarks: The workshop concluded with short remarks that summarized key takeaways and emphasized the importance of continued dialogue and collaboration. The participants were encouraged to apply the workshop insights to their professional and personal lives.

These workshops were recorded and transcribed using the generative AI tool embedded in Microsoft Word. Then transcripts were summarized by using ChatGPT-4o. The participants checked and edited the summary.

2.2.2. Plenary Panel Discussion

The plenary panel discussion was held on 26 September 2023 in a hall at the Tsukuba International Conference Center on the Tsukuba Conference 2023 (Figure 1). Table 1 presents the panel discussion program, which began with an introduction to the session's scope and methods, including the preliminary workshop. Subsequently, a representative from Group A read their letter (Box 1), followed by questions and comments by Group B (outgroup reflection). Then, the letter from Group B (Box 2) was read and discussed with Group A. The panel naturally transitioned into a general discussion with an invited discussant. In this paper, these letters are regarded as an output of the FD-applied workshop and

presented in the Results section with outgroup reflection, and the general discussion is incorporated into the Discussion section with post-conference reflections.

Table 1. Timetable of the Future Shapers Session of Tsukuba Conference 2023.

Time	Activity
17:30	Introduction to panelists
17:40	Introduction to the Future Design
17:45	Message from the Future Design Group A
17:55	Message from the Future Design Group B
18:05	Scientific interpretation
18:15	Panel Discussion
18:25	Comments
18:05	Panel Discussion (continued)
18:55	Wrap-up
19:00	Closure

3. Results: Letters from 2053

3.1. Group A: AI is as Close to Human as Food and Music

The letter from Group A (Box 1) mentioned technology and humanity as big issues from the viewpoint of an imaginary future generation. From a technological perspective, the group presented a cognitive relationship with AI in 2053 as close as “food and music” was in 2023. In the humanity aspect, the group presented an “expansion” of the African population, underlining the cultural identity rather than nationality, as well as an inclusive relationship with animals and plants. The letter concluded with the key messages to the current generation: “Be a human. Think. Struggle. Don’t be overconfident, stay humble.”

Box 1. Letter from Group A

25th September 2053

Dear 2023,

Quite unexpectedly, we find ourselves with the opportunity to write from the future and let you know what's in store. That's not as straightforward as you might think! What happens next very much depends on who you are, so it's difficult to offer advice that is widely applicable. But here are the big themes:

First, technology. You can see the major pieces taking shape from where you are now. But we all got important details wrong. AI. You can't compete with a machine and win, but there are alternatives to competing. Discover what you are and become that, as you have something they don't: 4 billion years of ancestry. Draw on those roots, because AI is closer than you realise—not just sooner, but closer to your soul. Close in the ways that food and music are close to you. Space exploration. I won't say any more because I know you like surprises—especially the ones that you make. Suffice to say, I think you'll be pleased.

Second, humanity. Africa rises. In 2053, a quarter of the people on Earth live in Africa—again the centre of human capital and innovation. Alongside this shift comes a quiet abandonment of individualism and its excesses, and a more appreciative embrace of community and its moderations. Of course, people still talk about investment and growth. But these days, when they say that, they're usually referring to health and education. As cultures expand and overlap, our identities as nationals give way to a shared identity as humans. And that is not the end of the expansion. More and more, the expanding circle includes animals and plants, the planet and beyond, the centuries ahead.

If all this sounds easy, believe me, it's not. We sometimes push back against changes that are unacceptable by our previous standards. Is that wise? It's hard to know. And we mustn't shy away from that. It is hard to know—if we are on the right track; if we have changed too much or not enough.

And that's where you come in.

Dear 2023. Be a human. Think. Struggle. Don't be overconfident, stay humble. Endure your ignorance as we all must. Our message to you is: don't worry, be happy. The future is far from perfect, but it is beautiful, and it is yours.

Sincerely,

[Group A members]

from 2053

There was no immediate feedback from the Group B panelists. Instead, a member of Group A explained why they mentioned space exploration: An expansion of human activity into space will be led not only by governmental institutes and agencies but also by private companies and investors, as exemplified by a project to bring humans to Mars in 10 or 20 years. The mention of the African rise was also reviewed by another ingroup panelist, who reiterated that humans would move towards community-based values and cultures rather than individual-based ones. It is widely applicable for the Global South. It was also pointed out that "expansion" commonly appeared in both contexts: physical expansion in space exploration and cognitive/cultural expansion in the African rise. The concluding message was a view of the imaginary future generation, inspired by a review of the situation of 50 years ago.

3.2. Group B: AI and Transformation of Self

The letter of Group B (Box 2) also emphasized the increasing integration of AI in daily life in an acceptable way. However, as an imaginary future generation, the group is concerned about a persistent risk of cybercrime and a transformation of the “self” concept. The group also mentioned “the pandemic of 2020” as a benchmark of global public health. The letter was concluded by listing keywords regarding technology (e.g., digital network, AI, and competency) and humanity (e.g., crime, ethics, equality, and inclusiveness).

Box 2. Letter from Group B

LETTER to the people in 2023

July 31st, 2053

We would like to share our observations about what living in 2053 is like.

The first thing we wanted to tell you is that society is highly digitized – it is beyond your imagination right now. But our day-to-day lives include both digital communities and tangible physical ones. Some of us live in one more than the other, but it depends on our friend and family groups, our jobs, and our hobbies. We use artificial intelligence a lot in our daily tasks – children grow up working with it in school. It is something we are all very used to now and accept because governments have been careful to implement it responsibly to ensure the privacy and safety of citizens.

A lot of the work you are doing now has been updated by AI technology. As you might imagine, this has benefits and harms and these are being discussed regularly. It is good for some of the elderly people in our communities because it enables them to stay connected with friends and "outside" life even if they have mobility issues. Many say that they are less lonely. There is still a socio-economic divide and inequality remains, but education is more accessible than it used to be and this has really helped rural areas because people do not have to leave to go to college or university.

Crime is still a problem because national governments have struggled to monitor cyber borders. Many countries are concerned about the power that digital platformers have over people's everyday lives. There are increasing efforts to try to control them but perhaps it is too late – they should have started in 2023! Many people are worried about the kind of control the digital platformers have over their personal data.

Something that is worrying those of us living in 2053, who remember 2023, is that it feels like our concept of "self" and responsibility for our fellow human beings have changed a lot. People's tendency to live in digital communities has meant that they are too individualistic and do not seem to have empathy. We worry about people's ability to connect with other people.

Believe it or not, the pandemic of 2020 is still playing a role in how we understand global health concerns. There have been more viruses since then, but vaccines have managed to keep pace. An added benefit has been that some of the science used in the development of new vaccines has also helped to make some of the deadliest forms of cancer much more treatable – and some are now curable. This has helped to improve people's trust in science but there are still challenges. Fortunately, researchers have been getting more support from their universities about how to better communicate the importance of their research.

- digital network
- artificial intelligence
- competency
- human identity / originality? / creativity?
- crime
- ethics
- responsibility
- equality
- inclusiveness
- human right

Time travelers from 2053

[Group B members]

One of the Group A members detected pessimism in the letter, particularly in the mode of communication between individuals. This was because historical views were, by nature, pessimistic.

There was an awareness in the group as an imaginary future generation that people were engaging more with machines than with other human beings. In such a community, the concepts of trust, love, and friendship, for instance, would not extend to others, and, if they did, it would be very difficult to sense how others were feeling.

This preference for machines reminded us of the great promise once we got the Internet and then social media, through which everyone would be connected and could contribute to a global conversation. An information technology expert in Group B was optimistic about technological development, believing that an increased number of communications would foster deeper understanding and empathy.

4. Discussion

The plenary discussion following the presentations revealed several recurring themes concerning the future of curiosity-driven sciences, ethics, and human society. Across disciplinary and cultural backgrounds, the participants repeatedly returned to questions of identity, historical consciousness, technological transformation, and social responsibility. These discussions also demonstrated both strengths and tensions inherent in applying the FD methodology, particularly regarding scientific robustness and ethical clearance. The following themes were identified in the plenary discussion's transcript.

4.1. Converging visions of AI and human identity

Most significantly, a thematic convergence between Groups A and B was observed in the pervasive integration of AI into future society and science. Although the tone differed between the two letters, both groups assumed that AI would become deeply embedded in everyday life and inseparable from education, communication, and social organization. In this respect, AI was not envisioned merely as a technological tool but as an environment shaping human cognition and identity itself.

At the same time, the discussions revealed contrasting expectations regarding the social consequences of digitization. Group A emphasized the possibility of expanded collective identities and community-oriented values, whereas Group B expressed concern that digital immersion could intensify individualism and weaken empathy. Nevertheless, both groups shared a concern for preserving meaningful human relationships amid technological acceleration.

This duality reflects a broader tension in contemporary discussions on AI ethics and digital society (Hanna & Kazim, 2021; Iphogen & Kritikos, 2019). Technological innovation was simultaneously associated with enhanced accessibility, communication, and medical progress, as well as with cybercrime, data control, and the fragmentation of social bonds. Rather than presenting a simplistic utopian or dystopian future, the FD exercise encouraged participants to explore the coexistence of opportunities and risks within the same technological trajectory.

The discussion further highlighted that future ethical challenges may not simply concern the regulation of technology, but also the transformation of concepts such as “self,” “community,” and “humanity.” Participants repeatedly questioned how humans would define themselves in increasingly hybrid digital-physical environments. Such reflections suggest that curiosity-driven sciences may need to engage more deeply in the future with philosophical and ethical inquiries into human identity itself.

4.2. Historical Consciousness and Future Imagination

Another major theme concerned the relationship between history and future thinking. One participant questioned whether learning history could constrain future imagination by reinforcing inherited conflicts, national identities, and historical grievances. This concern reflected an important methodological tension within FD: whether awareness of the past liberates or limits the capacity to envision alternative futures. One panelist took William Gibson’s science fiction novel *Neuromancer* (Gibson, 1984) as an example.

In response, several panelists argued that history should not be regarded as a static body of facts but as an ongoing process of reinterpretation. Historical knowledge was discussed as both narrative and evidence-based, enabling societies to learn from past experiences without being wholly constrained by them. Examples such as genocide prevention, environmental degradation, and newly discovered archaeological findings were invoked to illustrate how historical perspectives can expand, rather than narrow, future imagination.

Importantly, the discussion emphasized that multiple interpretations of history coexist. This plurality of historical perspectives was linked to diversity in future visions. One participant suggested that conflicting interpretations of historical events demonstrate the importance of perspective itself, and that such diversity should likewise be embraced in imagining future societies. In this sense, the FD process functioned not as a search for a single predictive future, but as a platform for juxtaposing multiple possible narratives.

These discussions indicate that historical consciousness may play a productive role in future-oriented deliberation when history is treated critically and reflexively rather than deterministically. The coexistence of multiple narratives allows participants to recognize contingency and uncertainty, thereby avoiding overly rigid or linear conceptions of progress.

4.3. Diversity, Inclusiveness, and Ethical Transformation

The workshops and plenary discussion also underscored the importance of diversity and inclusiveness in shaping future science and ethics. Participants repeatedly emphasized that future solutions to global challenges would require broader inclusion of voices across regions, genders, disciplines, and cultural backgrounds. The diversity of the panel itself was recognized as meaningful in generating alternative perspectives and questioning dominant assumptions about scientific excellence and social development.

In particular, discussions surrounding Africa's demographic and intellectual expansion highlighted the possibility that future innovation centers may shift away from historically dominant regions. This vision was accompanied by reflections on community-based values, collective well-being, and alternative models of development, echoing the Declaration of the World Science Forum 2022 held in Cape Town (World Science Forum, 2022). Such discussions challenged assumptions that technological progress necessarily entails increased individualism or Western-centered modernization.

The panel also acknowledged that ethical norms themselves are historically dynamic. Participants noted that concepts such as human rights, environmental responsibility, and acceptable technological practices have changed significantly over time and may continue to evolve in the future. This awareness introduced a critical perspective toward present-day ethical frameworks, suggesting that current values should not be regarded as universally fixed or final.

At the same time, participants stressed that ethical adaptation must not exclude marginalized communities. Concerns about persistent inequality, hunger, and uneven access to resources remained unresolved throughout the discussion. Although some participants envisioned a future in which poverty and hunger had largely been mitigated, others emphasized that achieving such outcomes would require substantial shifts away from purely profit-driven systems toward more equitable and inclusive forms of social organization.

These reflections demonstrate that future curiosity-driven sciences cannot be separated from broader questions of justice, representation, and social responsibility (e.g., Glerup & Horst, 2014). Scientific development was consistently framed not only as a technical endeavor but also as a moral and political process.

4.4. Implications of the Future Design Methodology

The discussion itself provided insights into the methodological implications of FD. By asking participants to act as imaginary future generations, the workshops encouraged a shift from present-oriented forecasting toward reflective backcasting. One participant described this process in terms of "consistency" between present and future selves: participants were encouraged to evaluate whether their current values and actions would remain justifiable from the perspective of future generations.

This temporal role-shifting appeared to stimulate both critical reflection and emotional engagement. Rather than discussing abstract futures detached from lived experience, participants articulated futures as if they were already inhabited realities. The resulting letters, therefore, combined speculative imagination with moral reflection and autobiographical projection.

At the same time, some participants identified limitations of the approach. One concern was that envisioning continuity between present and future could unintentionally reinforce existing social structures or privilege the perspectives of those already relatively satisfied with present conditions. This observation highlights the need for further consideration of how FD methodologies can better incorporate the viewpoints of radically marginalized or disadvantaged communities.

Nevertheless, the session demonstrated that FD could provide a productive framework for interdisciplinary dialogue on science, ethics, and long-term societal transformation. The coexistence of optimistic and pessimistic narratives, alongside conflicting assumptions about technology and humanity, suggests that the value of FD lies less in generating consensus than in enabling reflective engagement with uncertainty, plurality, and intergenerational responsibility.

5. Conclusion and Future Directions

This study explored how early- and mid-career researchers from diverse disciplinary and cultural backgrounds envisioned the future of curiosity-driven sciences and ethics by applying the Future Design approach at the Tsukuba Conference 2023. By positioning participants as imaginary future generations living in 2053, the workshops and plenary discussions generated reflective narratives concerning artificial intelligence, human identity, historical consciousness, inequality, ethics, and the social responsibilities of science. Rather than producing a single predictive scenario, the process illuminated multiple, sometimes conflicting perspectives on the future relationship among science, technology, and society.

Overall, the workshop was anchored on the following three themes. First, interdisciplinary reflection enabled participants to examine the past, present, and future simultaneously, thereby gaining a holistic perspective on the dynamic interplay between science, technology, and society. The combination of expertise from the humanities, social sciences, natural sciences, medicine, engineering, and sustainability studies fostered dialogues that extended beyond disciplinary boundaries and encouraged participants to reconsider assumptions embedded within their own fields.

Second, curiosity and ethics functioned as guiding principles throughout the discussions. Participants repeatedly reflected on the motivations underlying scientific inquiry while simultaneously questioning the moral responsibilities associated with technological innovation. In particular, the discussions surrounding AI demonstrated that future scientific curiosity cannot be separated from ethical considerations regarding identity, empathy, inclusion, governance, and justice. The workshop therefore highlighted the need to reconsider curiosity-driven sciences not as value-neutral endeavors, but as socially embedded practices requiring continuous ethical reflection.

Third, collaborative learning emerged as a central outcome of the workshop process. The FD framework encouraged mutual learning among participants by creating a space in which diverse viewpoints could coexist without requiring consensus. Through the exchange of contrasting future narratives, participants collectively explored uncertainties, fears, hopes, and responsibilities regarding future societies. This collaborative dimension was particularly important in addressing complex global challenges that cannot be understood from a single disciplinary or cultural perspective.

At the methodological level, the study demonstrated the potential of FD as a platform for interdisciplinary and intergenerational dialogue on science and technology. The exercise of imagining oneself as a future generation stimulated both cognitive and emotional engagement, allowing

participants to critically reassess present assumptions from a longer temporal perspective. At the same time, the discussions also revealed limitations of the approach, including the difficulty of fully incorporating the perspectives of socially marginalized populations and the challenge of balancing continuity with radical social transformation.

Several directions for future research and practice emerge from this study. First, future FD workshops should involve broader stakeholder participation beyond academic communities, including policymakers, industry actors, artists, civil society organizations, and marginalized groups whose perspectives are often underrepresented in discussions on future science and technology. While the inclusion of diverse actors may complicate discussions, such a multi-stakeholder approach is essential for envisioning and designing desirable futures. Second, comparative studies across different cultural and geopolitical contexts would help clarify how regional experiences shape visions of curiosity, ethics, and technological futures. Such an inclusive approach can foster greater awareness of diverse assumptions and conditions across regions, providing a critical foundation for future-oriented thinking. Third, further methodological development is needed to evaluate the long-term impact of FD participation on ethical awareness, intergenerational responsibility, and scientific practice. At the same time, it is important to acknowledge the inherent difficulty of developing methodologies for engaging with the future.

To conclude, the discussions in this workshop suggest that the future of curiosity-driven sciences will increasingly depend on the ability to integrate scientific creativity with ethical imagination and social responsibility. In an era characterized by rapid technological transformation and global uncertainty, envisioning desirable futures may itself become an essential scientific and civic practice, while also requiring a critical awareness of the limitations of contemporary scientific methodologies.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Figures



Figure 1

A snapshot of the plenary panel discussion on 26 September 2023 at a hall of Tsukuba International Conference Center.