

# AI4VIS EthiCards: A Card-Based Approach to Exploring Ethics in AI for Data Visualization Applications

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**Figure 1:** Materials used in our workshop for exploring ethics in AI4VIS applications include AI4VIS EthiCards, featuring six distinct card types, and instruction manuals designed for the Design Simulation and Role-Playing activities. The ready-to-print card deck and activity instructions are available at <https://aivisethicards.github.io/>.

## Abstract

AI4VIS EthiCards are a card-based approach designed to facilitate ethical exploration in the growing research of artificial intelligence (AI) for visualization (AI4VIS). The continuously increasing integration of AI and data visualization offers many benefits yet inevitably raises ethical concerns. AI4VIS applications, characterized by their interdisciplinary and multifaceted nature, necessitate that researchers, designers, and practitioners develop ethical awareness and critically reflect on their responsibilities within this domain. The AI4VIS EthiCards, organized into six types, i.e., **Goal**, **AI4VIS Task**, **Technology**, **Ethical Principle**, **People-In-Focus**, and **Challenge**, serve as a framework for discussion and ethical reflection. This card deck is designed for students, educators, and practitioners working with AI and visualization, and can be used as a flexible teaching framework, rapid reference, or self-check tool in small-group design and reflection activities. We refined the deck through five workshops and observed three main outcomes: participants' speculative yet feasible concepts revealed AI4VIS as a high-potential design space; the deck supported more nuanced ethical awareness; and it functioned as a multi-perspective scaffold and shared vocabulary that enabled people from different backgrounds to reason together across technological, user-centred, and value-oriented dimensions.

## CCS Concepts

• **Human-centered computing** → Visualization design and evaluation methods; HCI design and evaluation methods; • **Computing methodologies** → Artificial intelligence; • **Applied computing** → Interactive learning environments;

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## 1. Introduction

In this paper, we describe the AI4VIS EthCards set, and explain how the initial set was refined through a series of workshops and activities that engaged people in discussions and reflections on the ethical implications of AI for managing and enhancing visualization processes in applications. As the combination of AI, data, and visualization is reshaping domains such as finance, health, and politics, and many aspects of daily life, AI4VIS is transforming the landscape of data analysis and visualization design [WWS\*22]. For example, AI4VIS systems can generate data visualizations from simple natural-language queries, support clinical cancer management through deep learning and visualization [LCS\*23], and provide visualization recommendations using machine-learning-based approaches [HBL\*19].

As the world becomes increasingly data driven, AI4VIS techniques are likely to be embedded in many everyday applications, not only in specialist visualization tools. At the same time, AI-assisted coding and app-building tools (e.g., GitHub Copilot, Claude Code, Replit, and Subframe) enable many more people to take part in application development. When people can rapidly build AI4VIS applications without sufficient knowledge of data, visualization, or AI ethics, gaps in ethical awareness and education can amplify the risks of these systems.

However, insufficient attention to ethics can lead to algorithmic bias, political manipulation, misinformation, online hate, and the exploitation of human vulnerabilities [Dav20,HZMY23]. When ethical responsibilities in data collection and visualization are overlooked, visualizations can marginalize minority groups or reinforce political biases [Cor19, dK16]. These harms can arise even when AI4VIS is used with good intentions, as efficiency, convenience, or profit can easily overshadow ethical reflection. Existing guidelines for the ethical use of AI [JIV19,HZMY23,LP20,FC22], HCI [NVDM\*22], data [DK23], and visualization [Cor19] are important, but abstract principles alone are not enough, especially given the interdisciplinary nature of AI4VIS. People also need a basic grasp of underlying technologies, sensitivity to moral and social issues, and the ability to anticipate how design decisions affect different populations; cultivating these intertwined forms of literacy is essential for supporting ethical decision-making when developing and using AI4VIS systems.

To address this challenge, we developed AI4VIS EthCards and accompanying activities (Fig. 1) to scaffold reflection on ethical issues in AI4VIS applications. Building on prior research demonstrating the utility of card-based methods for ethical dilemmas [BKP20,BS23,HJM\*23], the deck comprises 62 cards organized into six categories: Goal, AI4VIS Task, Technology, Ethical Principle, People-In-Focus, and Challenge. We have studied, expanded and adjusted a preliminary concept of this deck [WHC24] that was based on an initial literature synthesis. The current AI4VIS EthCards deck marks the transition from a theoretical proposal to an empirically validated instrument. Employing a more rigorous literature analysis, we refined the original design, and significantly extended the deck from a purely technology- and principle-focused resource to one that connects AI4VIS with product/application design thinking.

We evaluated and iteratively refined this updated framework

through five workshops involving 89 participants across Canada and China, ranging from students to industry professionals. The contributions of this work are the combination of the AI4VIS EthCards and an exploration of how they can support teaching and learning. The card deck is designed to be operated in three complementary modes: 1) as a pedagogical scaffold that structures ethical learning in workshops and classrooms, 2) as a generative instrument that constrains and inspires early-stage ideation, and 3) as a critical auditing mechanism that supports reflective consideration of AI-driven designs for groups or individuals. Our findings suggest that activity-driven, card-based reflection helps teams discuss abstract ethical principles in context.

## 2. Related Work

### 2.1. AI for Data Visualization

Integrating AI into data visualization refers to multiple ways AI and visualization can be coupled across the pipeline. Recent surveys map this space: Wang et al.'s VIS+AI framework describes increasingly tight integration, from using visualization to present AI outputs to higher-level systems where AI learns from users' interactive analysis behavior and communicates back through visual interfaces. In parallel, Wu et al. define AI4VIS as applying AI to "visualization data" itself, treating visualizations (e.g., charts, dashboards, infographics) as a computational data format that can be parsed, generated, recommended, and checked. Wang et al. [WCWQ22] review ML4VIS techniques that focus on how machine learning can assist distinct visualization processes rather than only the final visual output.

Recently, large language models (LLMs) and other generative AI (GenAI) expanded AI4VIS from automation modules into mixed-initiative systems that can interpret natural-language intent, translate it into data transformations or chart specifications, and generate narrative scaffolding around visuals. LLMs enable data analysis [ZZZ\*24], natural-language visualization authoring [WTL24, WWZ\*24], and narrative data stories [LWQ23]. Ye et al. [YHH\*24] categorize GenAI4VIS techniques across pipeline stages (e.g., data enhancement, visual mapping, stylization, interaction), while Neri et al. [NMC\*25] synthesize visualization in AI-assisted decision-making, emphasizing interpretability for non-experts. Yang et al. [YLWL24] distinguish VIS4FM (visualization for understanding/evaluating foundation models) and FM4VIS (foundation models for generating/adapting/critiquing visualizations). This expanded AI4VIS space is ethically risky because systems can hallucinate plausible-but-wrong analyses or charts, obscure provenance and accountability by hiding data sources and transformations, and amplify bias and automation bias by steering how results are framed and trusted. These risks motivate lightweight scaffolds that help teams learn, discuss, and reflect on ethical implications of AI4VIS.

### 2.2. Ethics for AI and Visualization

Ethics in AI addresses risks across the AI lifecycle, including opacity, privacy and accountability failures, bias and discrimination, safety, and misuse [SW20, Ada21]. Meta-studies and principle-based work have mapped this space in detail [VA18,PAL18,Bod17,

GHS19, GB17]. Jobin et al. [JIV19] distill 11 recurring principles (e.g., transparency, justice and fairness, non-maleficence, responsibility). Yet a significant gap remains in translating these high-level principles into actionable design decisions. Purely technical or automated assessments often miss social context [SBF\*19] and cannot replace stakeholder-informed evaluation [MMW\*21]. Accordingly, prior work emphasizes situating ethics through applied methods such as case studies [RAB\*21], scenario-based analyses [Cox22], and value-sensitive design workshops [FKB02, CHB24], which is especially important in interdisciplinary domains like AI4VIS.

Visualization research similarly foregrounds ethics, including automation *black box* dilemmas, provenance, visibility, and privacy [Cor19]; power and neutrality critiques (e.g., feminist data visualization) [dK16]; and work on values and assumptions [DFCC13], empathy [LRA23], deception and misinformation [Cai19], and storytelling ethics [Dia18]. At the AI4VIS intersection, these concerns compound: uncertain model outputs, data provenance, and the perceived authority of visual encodings can jointly shape trust and decision-making. This motivates tools that help teams reflect on ethical implications in context while designing and critiquing AI-enabled visualizations.

### 2.3. Card-Based Approaches in HCI and Ethics

Card-based approaches have been widely used in HCI research [RW19, AGdJ\*20]. Described as “tangible idea containers, triggers of combinatorial creativity, and enablers of collaboration” [LDHB16, p.75], cards serve as effective scaffolds for structuring complex discussions.

In the realm of AI and technology ethics, several toolkits have emerged to support reflection. For instance, *AI Audit Cards* [AKB23] and *Judgment Call Game* [BCK19] cultivate AI literacy through reflection on social impacts; *IDEO’s AI Ethics Cards* [IDE], the *Human-AI Interaction Guidelines* [AWV\*19] and the *The Moral-IT Deck* [DUJC21] support ethical brainstorming in data-driven design; and the *Tarot Cards of Tech* [HJM\*23] and the *Responsible & Inclusive Cards* [EABSBS23] probe the implications of emerging technologies. Others target specific domains, such as legal awareness [LURG15], explainability strategies [LLM24], and identifying bias in project lifecycles [BS23].

A key gap remains at the intersection of AI, ethics, and visualization. Visualization-oriented decks (e.g., VizItCards [HA16]) rarely address AI-specific *invisible* risks such as *straining-data* provenance or hallucination, while general AI ethics cards often lack visualization-specific guidance (e.g., how encodings can mask uncertainty). As AI4VIS systems grow more complex and interdisciplinary, this motivates a domain-specific scaffold that links AI pipeline choices to ethical reflection. AI4VIS EthiCards fills this role as a lightweight deck that combines AI task specificity with value-oriented design inquiry.

## 3. Methods

To design a toolkit that effectively supports ethical reflection in AI4VIS, we established three primary **Design Goals (DG)**:

- **DG1: Ease of Use.** The cards need to be visually clear, organized, and designed for “pick-up-and-play” interaction without requiring complex or lengthy instruction.
- **DG2: Accessibility.** The content needs to support non-experts in meaningfully engaging with AI and data ethics by translating abstract concepts into relatable, actionable prompts.
- **DG3: Flexibility.** The framework needs to be adaptable across diverse topics and applications within data visualization.

Guided by these goals, we followed a three-stage iterative process (Fig. 2): **Stage 1** conducting a literature review and thematic analysis to identify key ethical dimensions; **Stage 2** developing the initial AI4VIS EthiCards and activities through collaborative synthesis and iterative discussions among authors; and **Stage 3** refining the toolkit through five workshops to analyze how it supported participants in identifying and reflecting on ethical issues in AI4VIS applications.

### 3.1. Stage 1 – Literature Review and Thematic Analysis

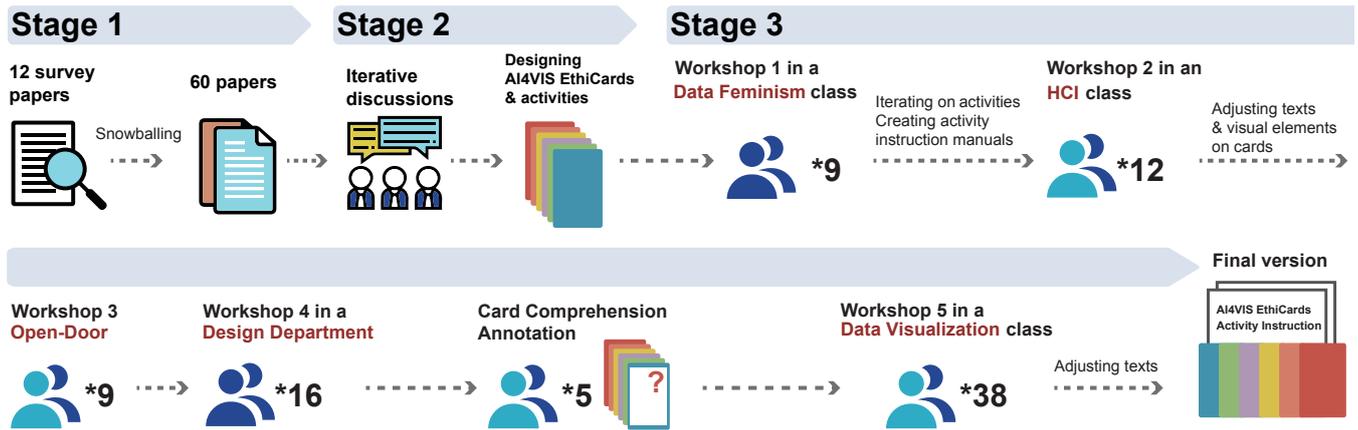
To identify the core dimensions relevant for ethical reflection in AI4VIS, we conducted a targeted literature review. We initiated a search for surveys on AI ethics and visualization ethics across four databases (ACM, IEEE, Google Scholar, and Semantic Scholar), identifying 12 seed survey papers based on titles and abstracts. These foundational texts provided taxonomies mapping AI4VIS, design ethics, and data ethics, illustrating how ethical debates cluster around specific technologies and user groups [NVDM\*22], as well as the importance of analyzing dilemmas from multiple perspectives [GD23].

We expanded this corpus through forward and backward snowballing and additional keyword searches (e.g., “AI ethics”, “data science ethics”, “visualization ethics”, “design ethics”), yielding a total of 60 papers. To translate this body of work into actionable design materials, we applied thematic analysis to distill the design space. Through consensus meetings to discuss discrepancies and synthesize the codes into higher-level themes, we finalized the recurring dimensions, such as technology, people, data, and design, and derived specific prompts to guide ethical discussion. These insights directly informed the conceptual descriptions and examples on the cards; for instance, ethical reflections on AR [HKSS17] highlighted design implications unique to immersive systems, while studies on children’s privacy and security [KOL\*23] helped shape the user-group-specific concerns in the *People-In-Focus* category.

### 3.2. Stage 2 – Card and Activity Design

In Stage 2, we operationalized the themes from the literature review into a tangible toolkit, focusing on selecting stable design dimensions and structuring their practical application.

First, we translated the recurring aspects from Stage 1 into candidate card types, informed by our pedagogical experience in HCI and visualization. Through iterative discussions, we refined an initial seven-category framework. We elected to remove specific *Case* and *Scenario* cards to enhance the toolkit’s **flexibility (DG3)**, allowing facilitators to introduce context-relevant examples ad hoc



**Figure 2:** Flowchart illustrating the three-stage iterative development of AI4VIS EthiCards: *Stage 1* – Literature Review, *Stage 2* – Card and Activity Design, and *Stage 3* – Evaluation and Iteration through Workshops.

rather than relying on static content. This process resulted in the final six types: Goal, AI4VIS Task, Technology, Ethical Principle, People-In-Focus, and Challenge—detailed in Section 4.

Second, we refined individual card content to ensure **accessibility (DG2)**. We distilled complex technical definitions into plain language and added concise examples to aid comprehension, while retaining citations for academic rigor. Finally, we designed the *Design Simulation* and *Role-Playing* activities (Section 5.2) to serve as the mechanism for weaving these disparate dimensions into a cohesive workflow for ethical reflection.

### 3.3. Stage 3 – Evaluation and Iteration through Workshops

To evaluate and iteratively refine the toolkit, we conducted five workshops and a card comprehension annotation study across diverse settings in Canada and China. These sessions spanned academic courses (Data Feminism, HCI, Design, Data Visualization) and professional contexts (an open-door industry workshop). After each workshop, two authors independently performed a thematic analysis on the collected data (including annotated cards, questionnaires, and observation notes) to identify usability bottlenecks and content gaps. Findings were then consolidated during 2–3 post-workshop debriefing sessions, where the research team discussed specific feedback items and finalized the design refinements for the subsequent iteration.

## 4. AI4VIS EthiCards

The AI4VIS EthiCards deck ([online digital version](#)) comprises 62 cards organized into six distinct categories: Goal, AI4VIS Task, Technology, Ethical Principle, People-In-Focus, and Challenge. To facilitate pick-up-and-play usability, the cards employ a consistent visual grammar with color coding and iconography. Each card distills complex academic taxonomies into concise definitions and relatable examples, serving as a scaffold to bridge the gap between abstract ethical theories and concrete technical implementation.

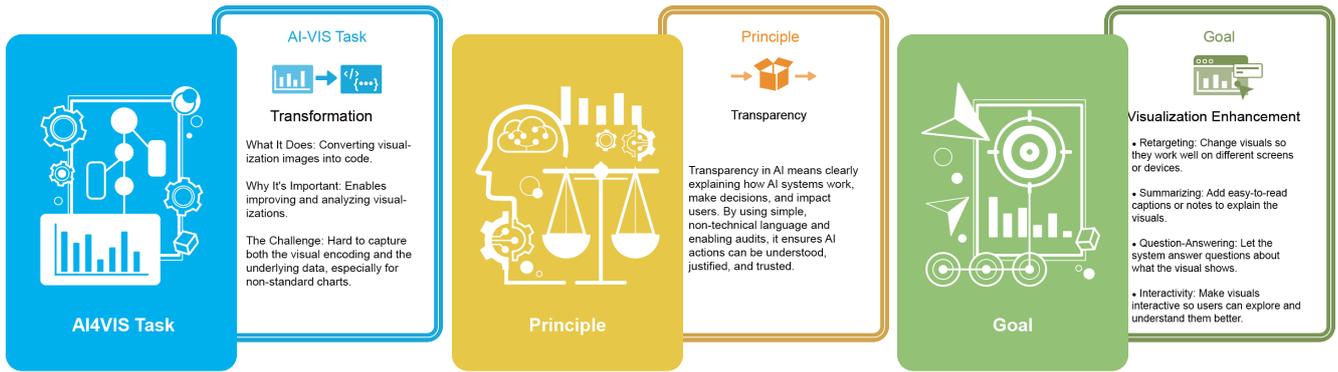
**Goal Cards: Defining the Intent** Goal Cards serve as the conceptual anchor, prompting participants to articulate the primary ob-

jective of their AI4VIS application. We adopted the taxonomy by Wu et al. [WWS\*22], i.e., comprising *Visualization Generation*, *Enhancement*, and *Analysis* to encourage participants to consider the full spectrum of AI interventions, from creating new charts to optimizing existing ones. By recognizing the high-level goals of applying AI4VIS, these cards help ground subsequent ethical discussions in clear design intent before participants assess potential unintended consequences.

**AI4VIS Task Cards: The Technical “How”** To provide a concrete vocabulary for *how* AI intervenes in the visualization pipeline, we adopted the task abstraction taxonomy by Wu et al. [WWS\*22]. The deck defines seven distinct tasks: Transformation, Assessment, Comparison, Querying, Reasoning, Recommendation, and Mining. Introducing these specific tasks helps participants move beyond generic discussions of “AI” to analyze the specific ethical implications of technical operations (e.g., the risk of bias in Recommendation versus the risk of hallucination in Transformation).

We selected this taxonomy because it offers a comprehensive, visualization-specific overview that remains *model-agnostic*. While the original survey focused on traditional machine learning (e.g., CNNs), recent work on Generative AI confirms that Large Language Models (LLMs) map cleanly onto these existing categories. As noted by Ye et al. [YHH\*24] and Yang et al. [YLWL24], GenAI tools function as components that enhance standard pipeline stages such as generating visualization code (Transformation) or summarizing insights (Reasoning). By grounding the cards in fundamental tasks rather than specific model architectures, the deck ensures relevance across evolving technologies.

**Technology Cards: The Deployment Context** Recognizing that ethical implications are often shaped by the medium of deployment, these cards ground the AI4VIS application in specific technological contexts. We adapted the typology of ethical targets by Vilaza et al. [NVDM\*22], which identifies common loci of ethical discourse such as Mobile Applications, Social Networks, and Games and extended it to include VR/AR technologies to account for the growing relevance of immersive analytics. Additionally, we included blank cards to allow participants to introduce emerging



**Figure 3:** Three examples of AI4VIS EthiCards showcasing the front and back designs. Each card provides a brief description to facilitate ethical discussions in the realm of AI4VIS.

technologies, ensuring the toolkit maintains the **flexibility (DG3)** necessary to address future innovations.

**Ethical Principle Cards: The Normative Framework** To provide a shared vocabulary for moral reasoning, these cards introduce normative values into the design dialogue, helping participants surface implicit assumptions [KB22]. We grounded this category in the global survey by Jobin et al. [JIV19], which distills 11 recurring principles from international AI guidelines, including Transparency, Justice, Non-Maleficence, and Solidarity. To meet our goal of **accessibility (DG2)**, we translated these high-level academic concepts into concise, plain-language definitions on each card, ensuring they function as practical heuristics for non-experts rather than abstract philosophical constraints.

**People-In-Focus Cards: The Human-Centric Lens** Involving People-In-Focus in the thought process aims to help participants analyze how relevant procedures are implemented with a human-centric perspective. This set of cards is derived from Vilaza et al. [NVDM\*22]’s review of where end-users have raised design questions and considerations of ethics in HCI. Since the categorization from Vilaza et al. was for summarizing themes identified from the literature, to adapt them to be used for activities and discussions on cards, we combined ‘Older Adults’ and ‘Children and Teenagers’ as ‘Age Variations’, classified ‘Women’ to a ‘Marginalized’ that includes gender variations, racial variations, various challenges such as communication and/or mobility, classified ‘Rural population’ to ‘Situational variations (e.g., rural, homeless)’. Additionally, we exemplified the needs of People-In-Focus to aid thinking, such as posing ethical questions for the children and teenagers group, like ‘How is children’s information collected? For example, children may accept some form of parental monitoring but resist monitoring that is constant or imposed on them with little explanation [KOL\*23]. Trust issues may arise when children discover that data is being used without their knowledge [vESK20].

**Challenge Cards: The Dilemma Engine** The Challenge Cards serve as the central mechanism for prompting critical reflection on ethical tensions. We synthesized these dilemmas from Correll’s work on ethical obligations in ML4VIS [Cor19] and D’Ignazio and Klein’s principles of feminist data visualization [dK16]. To encourage participants to interrogate the entire lifecycle of an application

rather than just the final interface, we adopted D’Ignazio et al.’s framework to structure the cards into two categories:

- **Input Questions:** Focus on the often-invisible processes of data collection, provenance, and labor (e.g., “How to visualize hidden labor?” or “Is diversity embraced in the process?”).
- **Output Questions:** Focus on the consequences of the visualization artifacts and user interaction (e.g., “How much guidance should analytics systems provide?” or “Should we rethink binaries?”).

Each card anchors these abstract questions in a concrete scenario. For instance, regarding the dilemma of *System Guidance*, the card contrasts the efficiency of automated insights against the risk of user over-reliance, prompting designers to consider how to maintain transparency and user agency. This structure encourages ethical discussions to remain grounded in specific design trade-offs rather than theoretical generalities.

## 5. Evaluation and Iterative Refinement

To evaluate the utility of the AI4VIS EthiCards and iteratively refine the toolkit, we employed an iterative design approach. We conducted a multi-site study comprising five workshops (n=89) and a supplementary Card Comprehension Annotation study (n=5) across three universities in Canada and China. These sessions were designed to observe the cards in use and to test the framework across different disciplines (HCI, Design, CS) and cultural contexts. The study protocol was reviewed and approved by the university ethics committee (#30002822).

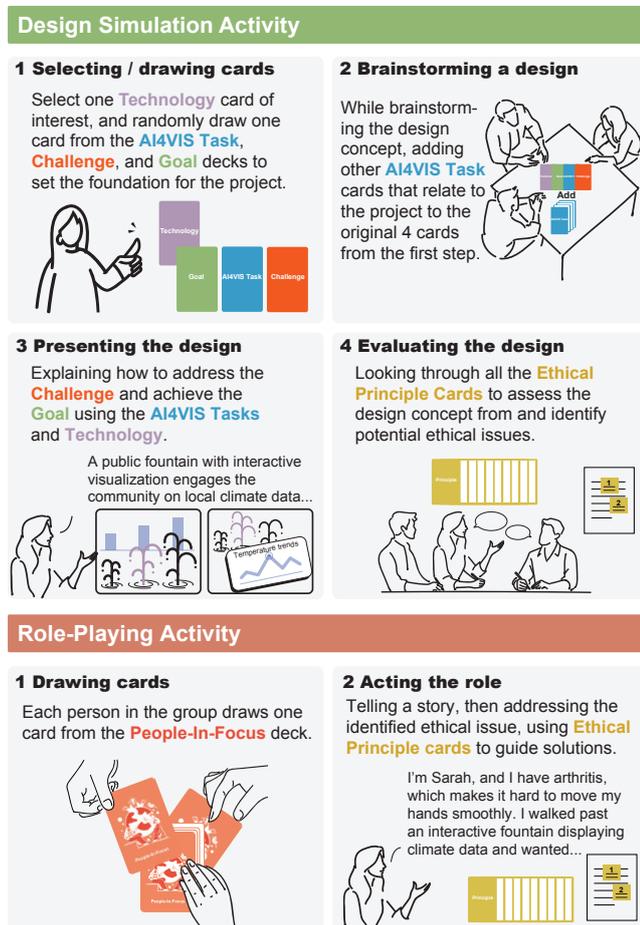
### 5.1. Participants

Participant recruitment was carried out through course announcements, local HCI Slack and Discord groups, online visualization communities, and institutional mailing lists, as well as through posters and email invitations. As detailed in Table 1, the participants spanned technical disciplines (Computer Science, Data Science) and creative fields (Digital Media, Product Design), allowing us to observe how the cards supported cross-disciplinary dialogue.

## 5.2. Activities and Procedure

The activities for the first four workshops drew inspiration from the *Vis Futures Cards* [DOW\*23] and *The Thing from the Future* card game [CW15], both designed to stimulate imaginative and speculative thinking, and incorporated role-playing techniques similar to those by Haghighi et al. [HJM\*23], which encourage multi-perspective evaluation of technology. In the W5, we introduced the cards as a reflective tool for students to assess the ethical implications of their own projects and existing AI4VIS examples.

The procedure in the first four workshops (W1-W4) consisted of two complementary activities (Fig. 4): Design Simulation, a project-based speculative exercise using AI4VIS techniques, and Role-Playing, a reflection-focused activity in which participants adopted stakeholder perspectives to review the designs created in the first activity. Together, these activities allowed participants to imagine novel AI4VIS applications while critically examining their ethical implications. During the workshops, facilitators observed participant discussions and activities, took notes and video recorded their presentations.



**Figure 4:** The two-stage activity workflow. Design Simulation encourages generative ideation by combining cards; Role-Playing prompts critical evaluation of those concepts from stakeholder perspectives. See the *activity instruction manuals* for detailed steps.

The refined workshop procedure consisted of four main phases: **(1) Introduction and Objectives (20 min)** — After completing consent and a demographic questionnaire, participants were introduced to the workshop goals: co-designing ethically aware AI4VIS concepts and providing feedback to refine the deck and activities. A brief primer connected the evolution of data visualization to contemporary tools (e.g., Tableau, Power BI) and the growing role of AI, highlighting emerging ethical challenges to prompt reflection.

**(2) Design Simulation (60 min)** — Participants, working in groups of three to four, were provided with a set of AI4VIS EthCards, sticky notes, pens, paper, and printed copies of the *activity instruction manuals* (Fig. 1). Participants combined Technology, Goal, and AI4VIS Task and Challenge cards to rapidly construct speculative concepts.

**(3) Role-Playing (30 min)** — Participants picked People-In-Focus cards, assigning them stakeholder roles, and used Ethical Principle cards to evaluate their own concepts from these perspectives. They articulated reflections using the prompt “I am XX, I try to XX, but XX,” and discussed how their designs might be refined to address identified ethical concerns.

**(4) Presenting and Reflecting (15 min)** — Participants then presented their projects, including the design concepts and reflections on ethical issues identified. The workshop concluded with a questionnaire that gathered feedback on what they liked or disliked about the cards and activities, what they learned from the workshop, and what they felt could be improved. Participants were also encouraged to annotate the cards and activity instruction manuals with comments on unclear content or suggestions for improvement. This feedback was used to iteratively refine our procedures and materials after each workshop.

Since not all content on cards was guaranteed to be viewed by participants during the workshops, we invited three undergraduate participants (two of whom had not taken part in previous workshops) and two graphic and UI designers with over ten years of professional experience to review each card individually in an offline **Card Comprehension Annotation activity**. They were asked to review every card, mark any parts they found unclear, and provide brief notes explaining their reasons.

In W5, we examined the cards in a practical context: a three-week data visualization course focused on designing and critiquing AI4VIS applications. Week 1 introduced the deck (60-minute lecture, walking through each card type and illustrating them with case studies). Students in nine groups were tasked to develop an AI4VIS concept and identify ethical issues in both their own design and a chosen existing case. Week 2 was self-directed in-class work, with the instructor circulating and providing guidance when needed. Week 3 concluded with project presentations. Students used AI tools such as ChatGPT, DeepL, Ernie Bot, Doubao, and DeepSeek, alongside Flourish and Adobe Illustrator.

## 5.3. Iterative Refinements

We iteratively refined the deck and activities across five workshops based on material annotations, Card Comprehension Annotations, and facilitator observations, focusing on three key dimensions:





ing paths, they remained anchored in a cohesive design scenario, preventing disciplinary silos.

In practice, this design enabled participants to bridge their respective professional vocabularies and ways of seeing. For instance, during a W2 discussion on AI-assisted navigation for people with low vision, computer science participants utilized Technology and Task cards to articulate specific automation capabilities and model operations. Simultaneously, design participants drew upon People-In-Focus and Principle cards to interrogate the same concept through lenses of user experience, sustainability, and trust. Instead of remaining in separate domains, the shared categories provided a concrete structure that allowed the group to connect technical model behaviors directly to interface design and social impact.

Consequently, the cards functioned as a common ground that coordinated expertise around common design problems, fostering a **shared vocabulary** for AI4VIS ethics. Participants noted that this structure enriched the workshop experience by exposing them to different facets of the domain, such as “*situational variations, different tools, and different methods*” (W1P2). Another participant observed that “*the discussion with my team, particularly because we come from different backgrounds and see things differently, enriched the workshop experience*” (W2P9). By validating multiple forms of expertise, the deck allowed participants to effectively coordinate their specialized knowledge within a cohesive cross-disciplinary dialogue.

## 7. Discussion

### 7.1. From Universal Ethics to Situated Evaluation

With the aid of the cards, participants could discuss ethical issues based on their specific project contexts rather than following a single standard. While traditional guidelines often strive for universal applicability, cultural relativism suggests that moral judgments regarding right and wrong should be understood within specific cultural contexts [Don84]. In the face of contemporary social complexity and diversity, our cards serve primarily as a source of inspiration and guidance rather than a rigid checklist. Participants are encouraged to interpret and extend ethical principles through their own cultural experiences. For instance, in W4, participants interpreted the ethical principle of Solidarity in distinct ways: one group emphasized respect for diversity, while another viewed collective knowledge sharing as the primary means of promoting solidarity. This adaptability aligns with feminist design methodologies [DK23, dK16], which value plural perspectives and resist imposing single, fixed definitions of ethical principles, thereby fostering inclusive and creative participation.

This situated approach is particularly critical for the field of AI4VIS, where data visualization is frequently perceived as a neutral, objective form of evidence. The AI4VIS EthiCards framework challenges this illusion of objectivity by surfacing the subjective value choices hidden behind algorithms and visual encodings. By facilitating discussions that link abstract principles to specific design decisions, the deck helps participants recognize that ethical AI4VIS is not a static state but a context-dependent practice.

Our cross-country workshops further underline the importance

of this situated evaluation. The card deck was used in Canada and China, two contexts with distinct cultural backgrounds, regulatory environments, and moral expectations. While participants in both settings engaged with the same set of ethical principles, their questions and priorities differed significantly. For example, a participant from W4 asked whether a local version of the deck should explicitly reflect “*our own policies, laws, and local values*”, helping designers see which practices are acceptable in their specific context. In this sense, the framework aligns with participatory approaches that treat ethics as an ongoing, collective negotiation. Instead of encoding a fixed notion of compliance, the cards provide a vocabulary that can be reconfigured to fit different institutional, cultural, and disciplinary settings.

### 7.2. Bridging the Gap between Abstract Principles and Design Action

While ethical principles for AI and visualization are well-established, a significant challenge remains in translating these abstract concepts into concrete design actions. Our findings suggest that AI4VIS EthiCards address this gap by functioning as a multi-functional instrument that operationalizes ethics in three distinct modes: as a pedagogical scaffold, a generative tool for ideation, and a mechanism for critical auditing.

First, the deck serves as a **pedagogical scaffold** that connects theoretical knowledge with hands-on practice. In educational settings, such as the Data Feminism and HCI courses involved in our study, the cards allowed students to bridge topics they were already studying like user-centered design and critical data perspectives with the specific technical realities of AI4VIS. By integrating the cards into existing curricula, educators could use them as flexible modules, ranging from short in-class exercises to scaffolds for multi-week projects. This mode of usage helps cultivate ethical literacy by ensuring that students do not view ethics as separate from the technical design process, but as an integral component of it.

Second, the cards function as a **generative tool for rapid ideation**, effectively embedding ethical considerations into the early brainstorming phase. A key advantage observed was the deck’s physicality and scannability, which minimized onboarding time and allowed participants to engage with complex ethical dimensions out-of-the-box. By spreading the cards on a table, teams created a tangible, shared reference that enabled them to quickly identify relevant aspects such as specific technologies or vulnerable populations, ensuring that critical considerations were not overlooked during the fast-paced design process (Fig. 5). This mode demonstrates how physical design tools can lower the barrier to entry for ethical reflection in dynamic workshop environments.

Third, the deck acts as a **mechanism for auditing and reflection**, supporting the evaluation of design outcomes. This was particularly evident in W5, where students used the deck to audit their own AI4VIS projects. The Ethical Principle and Challenge cards served as a checklist, enabling designers to critically evaluate their choices and identify potential failures. Furthermore, the vocabulary provided by the cards helped participants articulate how their specific design decisions aligned with ethical values during presentations. While our study primarily focused on educational scenarios,

these usage patterns suggest that AI4VIS EthiCards have strong potential for professional settings as reflected by professionals from the open-door workshop (W3), offering interdisciplinary teams a flexible method for rapid ethical alignment and project evaluation.

### 7.3. A Modular Scaffold for the Visualization Ecosystem

AI4VIS is inherently interdisciplinary, requiring practitioners to navigate the complex intersection of data science, artificial intelligence, and visualization design. The modularity of AI4VIS EthiCards allows the deck to function as a flexible plug-in component that integrates seamlessly with existing visualization pedagogies and design toolkits.

The deck acts as a complementary layer within the visualization ecosystem, bridging the specific gap of AI ethics without rendering other design tools redundant. For instance, in a futuristic workshop setting, facilitators might first use VisFutures to stimulate imaginative speculation about future visualization practices [DOW\*23]. AI4VIS EthiCards can be layered on top to ground these speculations, prompting participants to interrogate how AI-driven pipelines in those futures might be made accountable and who might be at risk. Similarly, the deck acts as an ethical companion to domain-specific toolkits like VizItCards for infovis design [HA16], the Urban Data Visualization deck [CNM25], or DataVisage for physicalization [ZHDR23]. In such workflows, participants can leverage existing resources to handle data encoding and visual aesthetics, while simultaneously using AI4VIS EthiCards to scrutinize the invisible aspects of the pipeline, such as training data provenance, model opacity, and downstream social harms.

Furthermore, this modular architecture supports extensibility, allowing the framework to evolve alongside the rapidly changing technology landscape. Participants in our study proposed “*extension packages*” tailored to specific needs, such as cards oriented toward UX design, policy regulation, or sector-specific risks. This suggests that AI4VIS EthiCards can serve as a foundational base layer that the community can build upon, ensuring the tool remains relevant across diverse domains and institutional contexts.

### 7.4. Limitations and Future Work

A primary limitation concerns the tension between **accessibility and technical depth**. The physical constraints of the card format necessitate concise descriptions, which inherently limit the ability to convey the full complexity of some AI mechanisms. While this simplification lowered barriers for participants from design and arts backgrounds, helping them grasp high-level opportunities, with more technical participants, more technical nuance for conveying specific technical opportunities, such as training procedures or algorithmic assumptions, would be appreciated. Future work could address this by developing an extended package for technical users that provides deeper, implementation-oriented details or by pairing the physical deck with a digital repository to ensure examples remain current amidst the rapid evolution of generative AI models.

Secondly, our workshops indicate that the deck can scaffold ethical reflection **during early-stage ideation and auditing**, but the

evaluation remains bounded by the workshop and teaching format. Random draws provided a low-friction entry point and diversified perspectives, but did not guarantee comprehensive exploration within a limited time, and outcomes varied with facilitation and time allocation. Teams generated plausible mitigations and iterated designs after they identified ethical risks. Establishing whether proposed mitigations meaningfully address ethical risks requires in-situ and longitudinal evaluation. Moreover, ethical reflection in real-world practice is shaped by organizational incentives, constraints, and liability risk, which may differ from classroom or workshop conditions. Our evaluation was primarily conducted with students and professionals in computer science and design (with a larger proportion of female participants). Future work should broaden stakeholders and conduct in-situ, longitudinal evaluations in industry settings.

Thirdly, card decks are one way to turn ethics knowledge into an activating design scaffold; future work can explore **alternative scaffolds and complementary implementations**. We chose a physical/digital deck because it is tool-agnostic, low-friction, and supports co-located discussion without infrastructure or data sharing. Ideas around variations on approach such as an LLM-based facilitator or theme-aligned agents that prompt reflection, flag overlooked considerations, and log rationales, would take further considerations and new studies. Future work could hybridize these approaches, e.g., a digital companion that functions as a guided worksheet, or an agent that tracks theme coverage and suggests “next cards.” Our current evaluation prioritizes multi-setting utility evidence and mechanism-focused observations; future work can also benchmark the AI4VIS EthiCards against other reflective scaffolds (e.g., worksheets/checklists and LLM-based critique tools) and evaluate relative tradeoffs across settings.

## 8. Conclusion

We presented AI4VIS EthiCards, a participatory approach to operationalizing ethics in the rapidly evolving field of AI4VIS. Through five workshops involving students and professionals, we demonstrated that the card deck functions as a boundary object that coordinates expertise across technological, user-centred, and value-oriented dimensions. The cards supported participants from a stance of blind technical optimism to one of situated, critical verification. By providing a shared vocabulary for interdisciplinary reasoning, with AI4VIS EthiCards, we suggest that ethics can be seamlessly integrated into the ideation phase, ensuring that future AI4VIS applications are built on a foundation of rigorous ethical scrutiny rather than compliance-based checklists.

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