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Master Computer Science

How do science comics convey scientific information? A case study on the production of a dystopian comic and evaluation of its impact on the public's understanding of AI trustworthiness

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Abstract

The rapid development of artificial intelligence (AI) and its complex social and ethical risks highlight the urgency of effectively communicating scientific knowledge to the public. While traditional media have limitations, science comics, with their unique visual language and narrative potential, are considered an effective alternative. This study aimed to explore how an original dystopian science comic can convey the complex issue of trust in AI to the public and assess its impact on public knowledge and critical attitudes.

To achieve this goal, this study created an original comic that uses a dystopian narrative to illustrate the risks of excessive AI application in social governance, incorporating key concepts such as the "black box" problem and biased algorithms. A pre- and post-test design survey was then used to assess changes in the knowledge and attitudes of 50 participants before and after reading the comic. The results showed that, while the overall effect of the comic intervention did not reach statistical significance, it successfully conveyed abstract concepts such as the "black box" and algorithmic bias, and initial observations showed it improved participants' understanding. Furthermore, the comic demonstrated the potential to cultivate critical thinking in participants, fostering a more prudent and critical attitude towards the societal applications of AI. Subgroup analyses further revealed the unique value of the comic in bridging language and professional barriers, with participants with lower English proficiency and non-computer science and law majors experiencing slightly greater knowledge gains compared to other groups.

These findings suggest that science comics, using engaging dystopian narratives as a vehicle, can not only effectively popularize scientific knowledge but also inspire audiences to think more deeply about the future of technology and society, providing important insights into the design and evaluation of future science communication.

1 Introduction

AI (Artificial Intelligence) is generally referred to as a system that replicates human rational thought and behaviour [Russell et al., 1995]. With recent technological advances, AI is driving technological innovation and transforming how we work, communicate, and interact with the world around us [Apell and Eriksson, 2023]. Human activity in all sectors leverages the potential of AI, including in the governance, regulation and legal sphere, where AI’s promise to support legal practice and enhance efficiency has garnered significant attention [Alarie et al., 2018, Wendel, 2019]. However, with the increasing use of AI comes a set of potential threats.

Not only do these threaten the technology, but they also touch on wide-ranging social and ethical concerns. Some of these threats arise from AI itself. For instance, the black box nature of AI, i.e., the decision-making, is unintelligible for humans. This results in a lack of transparency and potential bias in the algorithms, leading to unfair outcomes based on data bias [Pedreschi et al., 2019]. Other threats arise from the exploitation of AI. For instance, employing artificial intelligence algorithms to create fake media content (such as Deepfakes) for market manipulation [Luca and Zervas, 2016] and sexual violence [Ji, 2025] can severely compromise social trust and data integrity.

1.1 Public perceptions and attitudes regarding AI and AI risks

Amidst the speedy progress of AI technology and its sophisticated risks, public knowledge about AI, awareness of its risks, and attitudes towards it are characterized by multidimensional complexity and contradictions. On one hand, about half of international respondents report they do not understand AI; however, a tremendous 82% say they want to know more, suggesting a gap in knowledge alongside high interest [Pew Research center, 2025, Seth, 2024]. People who have a better understanding of AI are more inclined to trust AI and view its benefits as higher [Seth, 2024]. On the other hand, the public tends to be concerned about the potential risks of AI, with the foremost concerns revolving around cybersecurity, exposure to misinformation, inappropriate use of personal data, and job loss due to AI, among other particular issues. Among them, job loss concerns overwhelmingly surpass those of AI experts [Pew Research center, 2025].

In addition, the level of public acceptance and trust in artificial intelligence varies

greatly depending on the contexts in which it is used, ranging from the highest confidence in the healthcare sector to the lowest trust in human resources [Gillespie et al., 2023]. Public opinion is contradictory, viewing AI as an outstanding opportunity and a potential threat that needs stringent regulation. There is strong and widespread demand for effective regulation, with the public calling for greater agency over the implementation of AI in their lives [Pew Research center, 2025, Littman et al., 2022].

1.2 The great potential of science comics in science communication

The public must understand the basics of science to make informed decisions [Brownell et al., 2013]. Therefore, improving public understanding of AI and its risks will help the public make informed judgments and participate responsibly in its development and regulation. Communicating scientific knowledge to the public is increasingly considered the responsibility of scientists [Leshner, 2003]. The most common way to communicate with the public is to work with journalists to produce media such as newspapers, radio, television, and magazine reports. As the times change, online blogs and scientific websites are also common forms of medical research [Friedman, 2008]. Another common way is community outreach, which is to organize public lectures and seminars [Stevens, 2011]. However, these traditional channels still have limitations in popularizing complex scientific concepts. Specialized scientific language and abstract ideas are often complex to simplify into a form that the public can easily understand and accept [Friedman, 2008], and the public frequently lacks the background knowledge needed to understand this scientific information [Brownell et al., 2013, Goldstein et al., 2020]. In addition, in the school education system, there are practical obstacles for the general public who are not majoring in computer and AI to acquire AI knowledge systematically. If we want to encourage the public to develop scientific knowledge independently in their spare time, the key is stimulating their interest in the subject [Lin et al., 2013].

In this context, science comics, as a unique communication medium, show great potential in science communication. Comics are ‘a narrative form consisting of pictures arranged in sequence’ [Varnum et al., 2001]. With its narrative style that combines photographs and text, fascinating plots and vivid visual expressions, comics can effectively lower the threshold for understanding complex scientific concepts, visualize abstract scientific concepts [Wayne et al., 2024], and thus significantly increase people’s interest in learning emerging technologies [Lin et al.,

2014]. As a significant feature of comics, humour can attract people’s attention and interest, and enhance readers’ positive emotions and intrinsic learning motivation [Chen and Chih-Chun, 2006, Kennepohl and Roesky, 2008]. At the same time, comics’ visual image and narrative characteristics also make scientific content easier to understand, more imaginative, and more popular [Lin et al., 2014].

1.3 Research Purpose and Methods

While the scientific community recognizes the enormous potential of comics for disseminating scientific knowledge and several related research projects have been conducted, existing research on science comics primarily focuses on the natural sciences [Wayne et al., 2024], medicine [Delp and Jones, 1996], and nanotechnology [Lin et al., 2014] (all of which will be detailed in the related work section below). However, there is a lack of research on using comics to explore artificial intelligence’s social and ethical risks, particularly their impact on public knowledge and attitudes. This study aims to answer a core question: To what degree can we convey the trust challenges brought by AI in social governance, through an original science comic with a dystopian theme, and evaluate its impact on the public’s understanding of AI risk knowledge and the cultivation of critical attitudes?

To answer the research question, this study uses an original science comic as a communication medium to assess its impact on public understanding of AI risks and trustworthiness. This study employed a pre- and post-test design, collecting quantitative data on respondents’ knowledge and attitudes about AI risks before and after reading the comic. By analyzing the changes in pre- and post-test data and comparing audience groups based on different demographic characteristics (such as English proficiency, educational background, and age), this study aimed to assess the effectiveness of the science comic in communicating this specific topic.

1.4 Research results and contributions

This study found that although the comic failed to have a statistically significant impact on all participants overall ($p = 0.264$), it showed a positive dissemination trend and demonstrated unique communication value in certain key areas. This study demonstrates that the comic can effectively convey abstract concepts such as the "black box" problem and algorithmic bias in AI, and shows a positive trend in improving participants’ understanding of these concepts. Rather than simply enhancing audiences’ positive attitudes toward AI and its increased application

in government or daily life, this study found that comics prompted audiences to become more cautious and critical, suggesting that comics can cultivate audiences' dialectical thinking. The comic was most effective in improving knowledge among audiences with relatively low English proficiency and those from non-computer science or legal backgrounds, confirming their unique advantage in transcending language and professional barriers. Furthermore, additional findings from this study indicate that comics successfully sparked audiences' interest in further exploring the risks of AI, which is of great significance for promoting the public's continued participation in science communication.

1.5 Thesis Structure

This paper will follow the following structure: Chapter 2 will detail related work, including the results and discussions of cases using science comics for knowledge dissemination in different fields. Chapter 3 will detail the research methodology, including the original comic's creative process and design philosophy, and conduct an in-depth analysis of its content, illustrating how it materializes AI ethical and legal issues. As well as the design and implementation of the user survey. Chapter 4 will present the empirical results of the user survey. Chapter 5 will reflect on the limitations and weaknesses of this research. Finally, Chapter 6 will summarize this whole project.

2 Related work

This chapter aims to review the existing literature related to this study, first on the use of scientific illustrations in information dissemination and then on the specific role of science comics in science communication.

2.1 The application of scientific illustrations in information dissemination

The scientific community has long recognized the importance of media combining text and images (such as scientific illustrations) in information transmission and education [Ford, 1993]. In healthcare, research has shown that combining text and pictures significantly improves patient comprehension of and compliance with

complex medical information. For example, Delp and Jones [1996] conducted a three-month prospective, randomized, controlled study to evaluate the impact of cartoon illustrations on post-discharge care for patients with lacerations. Patients were randomly assigned to receive care instructions with cartoon illustrations or text-only instructions. The study found that using cartoons significantly improved patient reading and comprehension.

Furthermore, the positive impact of cartoons on comprehension and compliance was even greater for patients with lower educational levels and child caregivers. This methodology provides an essential basis for this study, as it evaluates the effectiveness of dissemination materials across different groups by comparing outcomes across individual subgroups. However, this study focused on specific applications within the healthcare sector, while this study aims to apply this methodology to the broader field of science communication.

2.2 The application of science comics in science communication

There are limited examples of research and empirical investigations into the effectiveness of comics in science communication and education, even though previous researches suggest that comics can be a helpful learning tool [Lin et al., 2014, Tatalovic, 2009]. However, some positive studies can be found in different scientific fields. In the Nanotechnology field, Lin et al. [2014] used a mixed-methods approach to investigate the effectiveness of science comics and traditional text manuals in promoting nanotechnology knowledge among the public. Their study randomly assigned 194 adults to two groups, each reading identical learning materials in different formats (comics and text). Using a pre- and post-test design and control group comparisons, the study systematically assessed the effects of both media on knowledge and attitudes. The results showed that comics and text manuals significantly increased public understanding and positive attitudes toward nanotechnology. However, in terms of affective perception, science comics had the potential to foster interest and enjoyment in continuing scientific learning, while text manuals had the opposite effect.

Similarly, Wayne et al. [2024] evaluated the effectiveness of science comics versus traditional academic texts (such as journal articles and popular science abstracts) in enhancing scientific knowledge and engagement among non-biology majors. The study randomly divided students into four groups (comic books, academic articles, popular science abstracts, and a control group) and used multi-group comparisons

to explore the effectiveness of different media. The results showed that comics were as effective as academic articles in disseminating knowledge. More importantly, comics had a unique advantage in enhancing student engagement: students who read comics were more likely to complete the material and were the only group to express a willingness to read scientific topics actively in the future. This further reveals the enormous potential of comics to enhance audience engagement and the desire to continue learning.

Similar to the method used by Lin et al. [2014] and Wayne et al. [2024], this study also employed a pre- and post-test design to assess changes in knowledge and attitudes, but without a control group. Unlike the two previous studies, this research lacked control groups, preventing us from directly comparing the effects of comics with other media. However, the primary goal of this study remained to explore the impact of the comic. To this end, the research conducted detailed subgroup analyses (including those based on English proficiency, educational background, and age). These analyses provided valuable insights into the differences in the effectiveness of the comic across different audience groups, reinforcing the core findings and providing valuable data for future research on communication strategies targeting specific audiences.

3 Methodology

This study aims to investigate the effectiveness of science comics as a communication medium in enhancing public awareness and attitudes about the risks associated with artificial intelligence (AI). To achieve this goal, this study employs a multi-step approach, involving creating and developing science comics and evaluating their effectiveness through pre-tests and post-tests using questionnaires. This chapter details the specific methods, tools, and processes employed.

3.1 Production of the science comic

The experimental stimulus for this study was an original science comic, focusing on the risks and challenges that AI may pose in the legal and social governance fields. The comic’s production process strictly adhered to the principles of science communication, aiming to present complex scientific concepts and legal issues in an accessible and engaging manner for non-specialist readers.

3.1.1 Theoretical Basis in AI’s Societal Impact and Governance

The comic’s storyline and core themes are based on an in-depth literature review of the application of artificial intelligence (AI) in the legal field and the regulatory challenges it presents. These discussions can be broadly divided into two main areas: the auxiliary role and potential risks of AI in various fields of society, and the urgent need for a robust framework for regulating AI.

Social applications and potential risks of AI:

Researchers are optimistic about the huge potential of AI to improve efficiency and optimize services, believing it is a powerful tool that can be applied in various fields from healthcare to social governance [Rashid and Kausik, 2024]. For example, AI’s superhuman capabilities in processing massive amounts of information are highly anticipated [Wendel, 2019]. It can greatly assist legal work, such as quickly finding important documents in evidence disclosure and transaction due diligence, and even generating some routine legal documents [Wendel, 2019, Alarie et al., 2018]. This means that lawyers can be assisted in tedious and repetitive work and devote more energy to more creative and strategic work [Alarie et al., 2018]. In specific legal application scenarios, we see that AI has begun to emerge in the field of law enforcement, such as drawing portraits of suspects [Saif et al., 2017], identifying license plates [Luo et al., 2017], analyzing the flow of funds on the dark web [Ghosh et al., 2017], and even monitoring public places [de Boer et al., 2017], for a complete overview, see [Raaijmakers, 2019]. In court practice, some software can help lawyers predict the court’s verdict on a case, which in the past often relied on lawyers’ experience and intuition [Alarie et al., 2018]. These applications have undoubtedly improved efficiency and brought new perspectives to legal practice.

However, these documents also clearly show that AI’s assistive role is not without boundaries. Although AI performs well in some aspects, it is far from completely replacing the core functions of lawyers. After all, legal practice is not just about information processing and pattern recognition; it also involves complex fact-finding, meticulous client counselling, creative advice, and on-the-spot responses in court [Wendel, 2019]. What is particularly critical is that legal reasoning requires normative judgment - precisely the ability that AI currently lacks [Wendel, 2019]. In addition, human moral judgments often involve emotions and intuition, and AI is still weak in this regard, which makes it unable to handle complex legal and moral intersection issues [Wendel, 2019]. Therefore, although AI can make lawyers’ work more efficient, the core functions of lawyers, such as assuming legal authority and responsibility relationships, still need to be performed by humans [Alarie et al., 2018].

Regulatory and governance challenges of AI

On the other hand, with the widespread application of AI, the legal and regulatory challenges it brings are becoming increasingly prominent, prompting us to reflect on how to regulate this technology through law effectively. Existing laws may no longer be sufficient to deal with the new problems brought about by AI and urgently need to be updated [Hoffmann-Riem, 2019]. The literature believes that the state must protect citizens' fundamental rights, rather than relying solely on some voluntary moral principles [Hoffmann-Riem, 2019]. There is a clear gap between the rapid development of AI and the lag of law [Greenstein, 2022].

Primarily, when AI is used to assist or even dominate some decision-making systems, its inherent "black box" characteristics become a serious challenge to the core principles of the rule of law: transparency and accountability [Richmond et al., 2024]. In the research of [Greenstein, 2022], the COMPAS (Correctional Offender Management Profiling for Alternative Sanctions) risk assessment software in the United States and the SyRI (System Risk Indication) welfare fraud identification system in the Netherlands have raised concerns about the rule of law due to a lack of transparency and potential bias. The literature highlights that AI may lead to declining legal accessibility, discrimination caused by data bias, abuse of power resulting from technology concentration, and even challenge traditional legal principles, such as the "presumption of innocence," weakening people's right to question automated decisions. A more profound concern is that AI may weaken human initiative and autonomy, while the fundamental purpose of the rule of law is to promote human prosperity.

In the face of these challenges, researchers have proposed a variety of regulatory ideas:

- **Building a regulatory framework:** A clear framework is needed to balance innovation and the public interest [Petit, 2017]. [Carrillo, 2020] has suggested that regulation should not simply apply old methods, but should be based on the characteristics of AI and consider the diversity of AI types. International law is fundamental due to the cross-border nature of AI. There are even proposals to establish international organizations to regulate AI and formulate international treaties to protect basic rights and clarify the legal status of AI.
- **Clarify responsibility:** Under the existing legal framework, holding AI and robots accountable for damages is still legally complex. Therefore, it is worth considering improving the law to adapt to the new responsibility issues brought about by AI [Petit, 2017]. It is worth noting that this is precisely

the issue that recent legal frameworks such as the EU AI Act are trying to address. These laws provide a concrete legal response to how to define and allocate liability arising from AI by clarifying that AI itself does not have legal liability and that responsibility ultimately belongs to human subjects [Deloitte, 2024].

- **Emphasis on transparency and explainability (XAI):** In the research of [Richmond et al., 2024], this is the core of dealing with the AI “black-box” problem. Although complete algorithm transparency may involve commercial interests or system security, excessive confidentiality will inevitably lead to injustice. Therefore, it is crucial to establish a hierarchical and targeted transparency mechanism. Legal and AI experts collaborate to develop new taxonomies to better connect legal reasoning with AI decision-making mechanisms and make deep neural network models (DNN) more transparent and understandable to legal professionals.
- **“Legal protection by design”:** This is an innovative concept proposed by [Hildebrandt, 2018]. It differs from “legal by design” and focuses on protecting individuals’ ability to challenge automated decision-making systems. This requires legal professionals to actively participate in developing AI legal intelligence to ensure it complies with the principles of law and the rule of law.

In summary, regulating AI requires deeper thinking, not only on the technical level, but also on the macro-impact of AI on society, politics and economy [Carrillo, 2020]. The key is how to effectively prevent the possible harm caused by AI while promoting AI innovation, and take the value of the rule of law as an essential starting point [Greenstein, 2022].

It’s worth noting that the international community is actively translating these principles into concrete legal frameworks. The European Union’s Artificial Intelligence Act (EU AI Act) is a prominent example. This Act adopts a risk-based regulatory approach, categorizing AI systems as unacceptable, high, transparency, and other risks. It also imposes strict mandatory requirements on high-risk systems, including transparency, explainability, and human oversight [Deloitte, 2024].

3.1.2 Production Steps of the comic

In the research by Friesen et al. [2018], the framework for converting complex scientific publications into easily understandable comics consists of four steps. The

production process of this comic mainly refers to these four steps:

1. Development of a Conceptual Foundation

The conceptual foundation in this study can refer to the unification and summary of the research points obtained in the previous literature review [Friesen et al., 2018]. The core research point of this study is that the widespread use of AI in society and the rule of law brings significant risks, including black box characteristics, algorithmic bias, and human abuse of AI, and the corresponding supervision and solutions, including transparency and accountability. Based on these core research highlights, the basic concept of this comic could be derived: How can we reduce or avoid the social risks brought about by the widespread use of AI? Based on this, some science fiction metaphors were added as a hook to attract the audience: a dystopian society (for example, a future society using AI systems to score and manage citizens), a supervillain (a government official who knows that the AI system algorithm is biased but still uses it), and a superhero (the protagonist who is determined to expose the truth to help everyone).

2. Development of a Scientifically-Relevant Setting

The setting is rooted in these conceptual foundations and presents the themes intuitively. This comic is set in a future society heavily reliant on an AI-powered social credit system. This setting is a possible future imagining of the basic concepts. By visualizing scenarios in which AI systems operate, including in fields such as healthcare, transportation, and media [Rashid and Kausik, 2024], the comic aims to avoid excessive use of obscure technical terms, allowing readers to understand how AI risks permeate their daily lives through the story itself rather than complex explanations.

3. Development of Characters

The character is a bridge connecting readers with scientific topics, aiming to depict the main scientific elements and research content and arouse readers' emotional resonance [Friesen et al., 2018]. In this comic, the protagonist, Astraea, was created. As a journalist, she not only represents the general public affected by AI but also is the core driving force for revealing the risks of AI. In addition, to demystify the inevitable professional terms and maintain the relaxed narrative style of the comic, a science communicator character is also needed [Friesen et al., 2018]. In this comic, Minerva, a former engineer, was involved in setting up and maintaining AI systems. She is the science communicator who explains both Astraea and the readers about the flaws and biases of AI algorithms, and guides Astraea on how to disseminate

articles through other methods after being blocked from reporting rights, so that the public can access the truth.

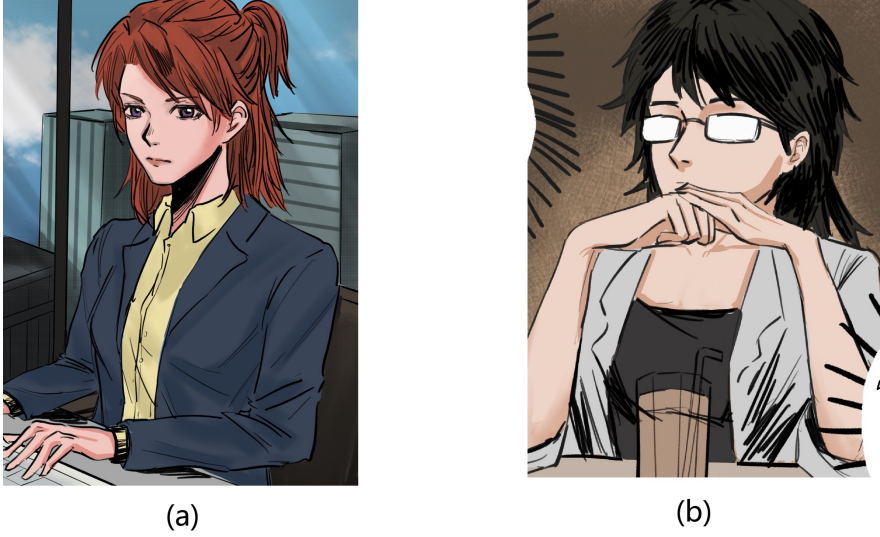


Figure 1: Astraea (a) and Minerva the ex-engineer (b)

4. Development of a Detailed Storyboard

Storyboarding is a key step in visualizing concepts, transforming the concepts, scenes, and characters constructed above into a concrete visual narrative. The storyboard details the theme of each page, panel descriptions (including intended images), and text sections (such as speech bubbles, titles, etc.). This study described the storyboard content in words, converted into sketches, and finally filled with colour and text.

3.1.3 Storyline Generation and Plot Design

A science comic centered on complex scientific knowledge, its cornerstone is precisely a complete story [Faria et al., 2024]. Because the narrative content and structure of the story are similar to our daily content, it makes scientific materials easier to understand [Jee and Anggoro, 2012]. Although this narrative structure is rarely used in scientific communication [Farinella, 2018], this study chose it to create a complete storyline for the comic. The knowledge points that readers need to learn are integrated into the storyline.

To give the story a more realistic and persuasive context, the storyline incorporates multiple real-world events and concepts related to AI algorithms. For example,

the AI bias and opacity depicted in the comic echo the real-life examples of the Dutch childcare subsidy scandal [Amnesty International, 2021] and ProPublica's "Machine Bias," [Angwin et al., 2022], which demonstrate how algorithms can have devastating effects on the lives of innocent individuals. Furthermore, the AI credit system in the story, its operating mechanisms, and potential harms align closely with the concept of "weapons of mathematical destruction" (WMDs) proposed by Cathy O'Neil in her book, *Weapons of Math Destruction*.

The comic storyline is set in a future social credit system that relies heavily on AI for social management and citizen ratings. It was inspired by *Nosedive* [Wright and Davies, 2016], the first episode of the third season of Black Mirror directed by Joe Wright. This setting echoes the concepts of "algorithmic governance" and "state regulatory responsibility" proposed by Hoffmann-Riem [2019]. The core plot revolves around journalist Astraea, who faces personal difficulties due to the "technical flaws" of the AI system and subsequently conducts an in-depth investigation to expose the truth behind the human manipulation and data bias behind the system.

The comic reveals AI's inherent flaws and external biases through specific cases. For example, in the story, an elderly man undergoing four chemotherapy sessions per month is labelled a "medical resource abuser" by the system, resulting in a plummeting credit score and the denial of medical rights. This directly reflects Raaijmakers's view that AI results can be skewed due to data selection or inherent inductive biases, and aligns with Greenstein's argument that AI challenges the principle of "presumption of innocence" and infringes on fundamental rights. When the protagonist, the reporter, attempts to appeal on behalf of the elderly man, the system prompts, "The success rate of similar appeals is only 12%." This vividly illustrates the dilemma described by Raaijmakers [2019] of "lack of explainability leading to unfair law enforcement," as well as Greenstein's concern that AI's "black box" nature undermines people's right to challenge automated decisions.

The series of penalties suffered by the reporter due to his declining credit score was attributed by Petit [2017] to "systemic externalities," confirming Hildebrandt [2018] criticism of the law's degeneration into a statistical simulation. Subsequently, the journalists' in-depth investigation revealed that the AI system's flaws stemmed from an overreliance on 20-year-old data on health insurance fraud, revealing the human biases and value judgments embedded in AI design [Greenstein, 2022]. More importantly, engineers noted that the system was particularly tolerant of errors by certain groups, directly echoing Wendel [2019] core point about AI's difficulty in addressing normative judgments such as fairness in law. The

story emphasizes that the risks of AI lie not only in technical flaws but also in how those in power exploit known flaws to protect their interests and consolidate power. This is a reflection of the real-life Cambridge Analytica scandal [Boldyreva et al., 2018].

At the end of the story, under public pressure, the government introduced new laws requiring AI systems to disclose their scoring logic, establish a human appeals channel, and introduce human juries. This outcome aligns closely with Carrillo’s emphasis on the need for an international legal framework and Richmond et al.’s proposals for solutions such as "Transparency and Explainability (XAI)." It also confirms Lin et al.’s observation that public attitudes toward emerging technologies can influence their development.

The comic ultimately elevates its core idea through the protagonist’s speech: “The real AI crisis lies not in technological flaws, but in those in power exploiting known flaws to protect their interests and consolidate power.” This core message is consistent with the view in the literature review that AI unfairness reflects and amplifies social biases and human choices [Raaijmakers, 2019, Greenstein, 2022].

3.2 User Survey Questionnaire Production and Implementation

In science communication, rigorous evaluation of communication activities and programs is becoming increasingly important. Evaluation can reveal the effectiveness of science communication activities and provide valuable feedback to practitioners and researchers to improve future communication strategies [Volk and Schäfer, 2024]. Rigorous assessment should focus on feasible objectives, select appropriate methods, ensure thorough research designs, and comprehensively consider the context of communication. These evaluations should go beyond simple quantitative statistics to investigate how communication activities influence audiences’ cognition, attitudes, and behaviours [Volk and Schäfer, 2024]. This study uses science comics as an innovative communication medium, and evaluating their effectiveness is particularly critical. In order to verify the effectiveness of comics in conveying scientific knowledge, this study designed a questionnaire for pre-tests and post-tests. The science communication effectiveness evaluation and questionnaire design for this study were completed under the guidance of IMPACTLAB.

3.2.1 Questionnaire Design

This questionnaire aims to systematically measure the specific impact of the science comic as a communication project. It assesses effectiveness in the following areas: knowledge, attitude, and interest. The questionnaire was structured into three main parts

- **Informed consent and demographics:** Participants will be informed in detail of the purpose of the study and how their data will be used (anonymity and aggregation). After they confirm that they understand the information and voluntarily continue to participate in the survey, they will be shown the next questions and read the comic. In the demographic part, the research collected information about participants through four questions, including English proficiency, education level, whether they had an educational background in computer science or law (three multiple-choice questions), and age (an input question), for subsequent group analysis. Because the comic strip was written in English, this research wanted to assess whether different levels of English proficiency would produce different results. Because this comic focuses on AI governance within a legal context, we specifically sought out participants with legal backgrounds, as their knowledge is highly relevant to the contexts covered in the comic (e.g., governance, regulation, and law). We also specifically sought out participants with computer science backgrounds, as their expertise is closely tied to AI technology itself. The study also had the same research idea for the questions about education level and educational background, exploring whether varying levels of education and educational background would impact the results differently.
- **Pre- and Post-test of Knowledge and Attitude:** This section includes 7 Likert-type questions, divided into two subscales. Three of the questions belong to the knowledge subscale (e.g., Do you agree that AI algorithms may be biased and unfair?), and the other 4 belong to the attitude subscale (e.g., Do you think AI can promote the efficiency and fairness of the judicial system?). The knowledge subscale is used to assess participants' understanding of the potential risks of AI in legal and social governance (such as "black box" problems and algorithmic bias), while the attitude subscale is designed to assess the audience's perception, concerns, and acceptance of AI and its risks. After answering the seven questions in the pre-test, participants were asked to read the science comic book "Black Box" included in the questionnaire. After reading it, they were asked to answer the same seven questions again.

- **Communication Effectiveness of the comic:** This section contains two Likert scale questions, one to assess the impact of the comic on participants' interest in learning about the risks of artificial intelligence (After reading the comic, I want to know more about the risks of AI.). The other is to evaluate whether the comic makes participants think they have learned knowledge about the risks of AI (After reading the comic, I now know more about the risks of AI.).

3.2.2 Data collection and data analysis

This study used an online questionnaire as the primary data collection method to ensure efficient and widespread reach of the target audience. All questionnaires were developed and published using the professional survey platform Qualtrics, which ensured data security and a smooth collection process.

After publication, the questionnaires were widely disseminated across multiple mainstream social media platforms, such as LinkedIn, Reddit, Facebook, and WeChat. These platforms were designed to reach potential participants with diverse backgrounds and interests, obtaining a diverse sample. The questionnaire link was embedded in the text, clearly stating the research objectives, participation requirements (including reading the comic), and the estimated time required to ensure voluntary and informed completion by participants.

To evaluate the effects of comics on participants' knowledge and attitudes, we primarily used paired-sample t-tests.

The paired-sample t-test is a commonly used statistical method that compares the means of two matched groups or the means of the same group at two different time points [Ross and Willson, 2017]. Given that this study employed a pre-test/post-test design, where the same participants were measured twice before and after the comic intervention, the paired-sample t-test was the most appropriate tool for evaluating the effects of comics. It effectively eliminates the influence of individual differences on the results, allowing for a more precise analysis of the changes brought about by the comics intervention itself.

The t-test was also used in the subgroup analyses to explore differences in the effects of comics across different English proficiency levels, educational backgrounds, and age groups.

4 Results

This section presents the results of the analysis of the collected data. We will first provide a demographic overview, then detail changes in participants' knowledge and attitudes before and after the comics intervention. Finally, we will conduct subgroup analyses to explore the differential impact of comics on different audience groups.

4.1 Demographic Overview

This study sent questionnaires online, and the number of questionnaires distributed was not counted. Among the questionnaires received, those that answered all questions completely were considered valid questionnaires, a total of 50 questionnaires.

Figures 2 to 5 present basic demographic information about the study participants. Specifically, Figure 2 shows the age distribution of participants, Figure 3 shows the English proficiency of participants, Figure 4 shows the educational background of participants, and Figure 5 shows the education level of participants.

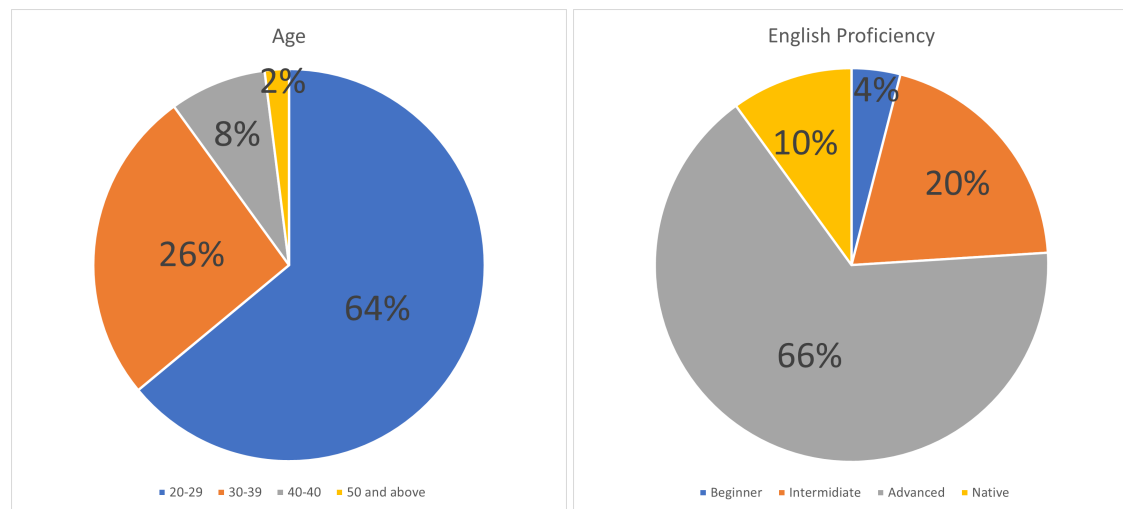


Figure 2: Age Distribution of Participants Figure 3: English proficiency of participants

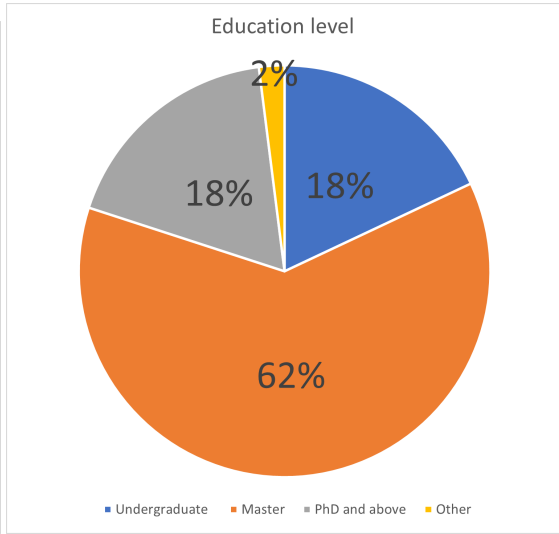
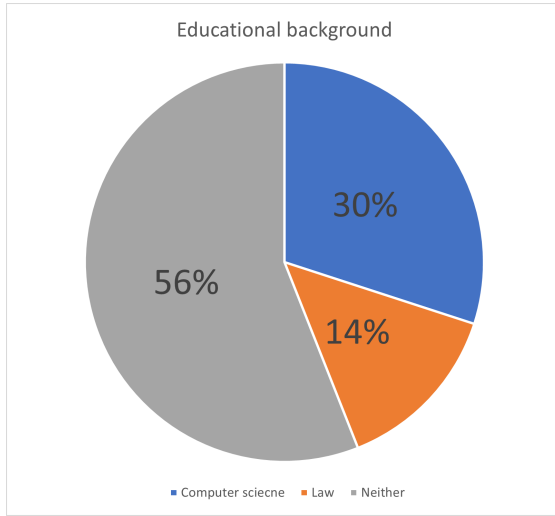


Figure 4: Educational background of participants Figure 5: Education level of participants

The participants of this research are primarily young. The largest group is between 20 and 29 years old, accounting for 64% of the total. Although this is an English questionnaire, the respondents' English proficiency is generally high, with more than two-thirds of the participants considering themselves to have an advanced or native language level. In terms of educational background, the participants' educational level is also generally high, with more than 80% of the respondents holding a master's degree or above. In addition, regarding professional background, the largest number of participants have a non-computer or legal background, accounting for 56% of the total.

To more accurately display participants' age distribution, a cumulative distribution function (CDF) plot was created, as shown in Figure 6. This chart provides a clearer and more continuous view of the age distribution, highlighting the central tendency of the respondents' ages.

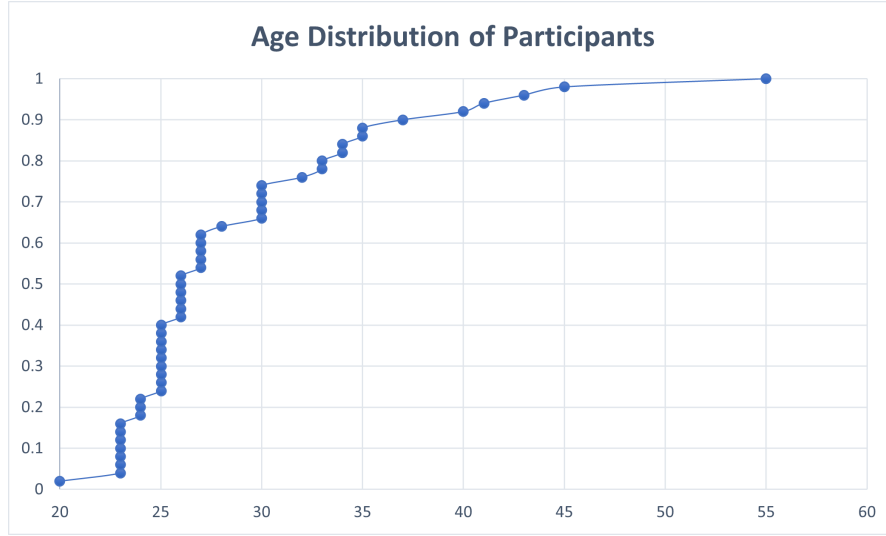


Figure 6: CDF plot of age distribution

These demographic characteristics provide important insights for subsequent analysis of the comic’s effectiveness on different audience groups.

4.2 Have people’s knowledge of AI risks improved?

This section aims to evaluate the effectiveness of the comic in enhancing respondents’ understanding of core AI risks by comparing pre- and post-test data on three key questions.

Comprehensive quantitative results

A paired samples t-test was used to test whether there was a difference in the mean scores of knowledge questions before and after reading the comic. Table 1 provides the pre-test and post-test mean scores, standard deviations, the t-value, and the p-value of the knowledge part.

The average score was calculated as follows: For each participant, we added their Likert scale scores (1-5) on all knowledge questions and divided them by the number of questions (3) to get an average score representing the participant’s overall knowledge level. Finally, we summed up the average scores of all 50 participants and divided them by 50 to calculate the overall composite average score for the group. This method was used to calculate the average scores for the pre-test and the post-test.

Group(n)	Mean scores	SD	t	p-value
pre-test(50)	3.81	0.56	1.129	0.264
post-test(50)	3.89	0.53		

Table 1: Pair t-test of knowledge part

The analysis showed that the mean score on the pre-test was 3.81 (SD = 0.56), and on the post-test was 3.89 (SD = 0.53). The t-value is 1.129, and the p-value is 0.264. Although this study failed to prove that the comic significantly improved the knowledge of all participants ($t = 1.129$, $p = 0.264$), the mean score increased slightly from 3.81 to 3.89, and the standard deviation decreased slightly from 0.56 to 0.53, indicating that the comic had a positive impact on participants' knowledge of AI risks.

The research also compared the mean scores of the three core knowledge questions (Q1-Q3) before and after comic reading for each participant. Figure 7 uses a Sankey diagram to visually present the changes using before-and-after plots.

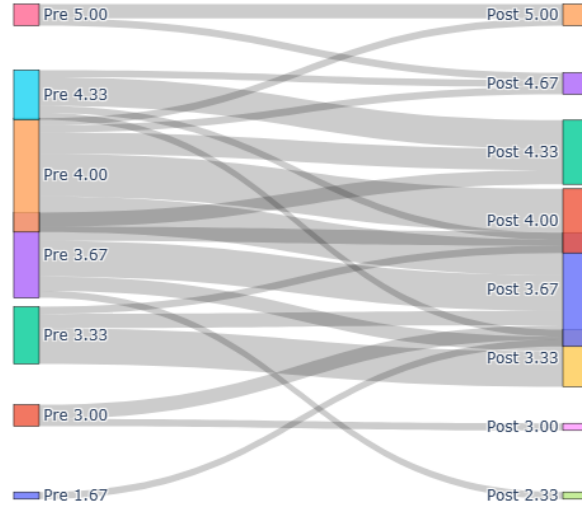


Figure 7: Changes in the pre-test and post-test mean scores of the three knowledge questions

Based on pre- and post-test data from all 50 participants, we observed a positive trend in comics improving knowledge. Among all participants, 23 saw an improvement in their knowledge scores; 11 saw their scores remain the same; and 16 saw their scores slightly decrease.

The number of participants whose scores improved outnumbered those whose scores decreased, indicating that the comic has a role in conveying knowledge. Specifically, the participant who improved the most increased the score from 1.67 on the pretest to 3.67 on the posttest.

Individual problem analysis

The specific data distribution of each knowledge question was analyzed to gain a more nuanced understanding of the comic's impact.

Figure 8 provides the differences in the Likert scale distributions between the pre-test and post-test for the first knowledge question: Artificial intelligence can be used in the judicial field (such as assisted trials and legal consultation). Regarding this knowledge point, the results showed that the comic positively impacted the respondents. After reading the comic, the percentage who expressed agreement or strong agreement increased from 42% in the pre-test to 48%. Meanwhile, the percentage who held a neutral attitude decreased from 28% to 22%. This change suggests that the comic successfully moved some previously hesitant audiences toward a more positive stance, prompting them to form more definitive opinions.

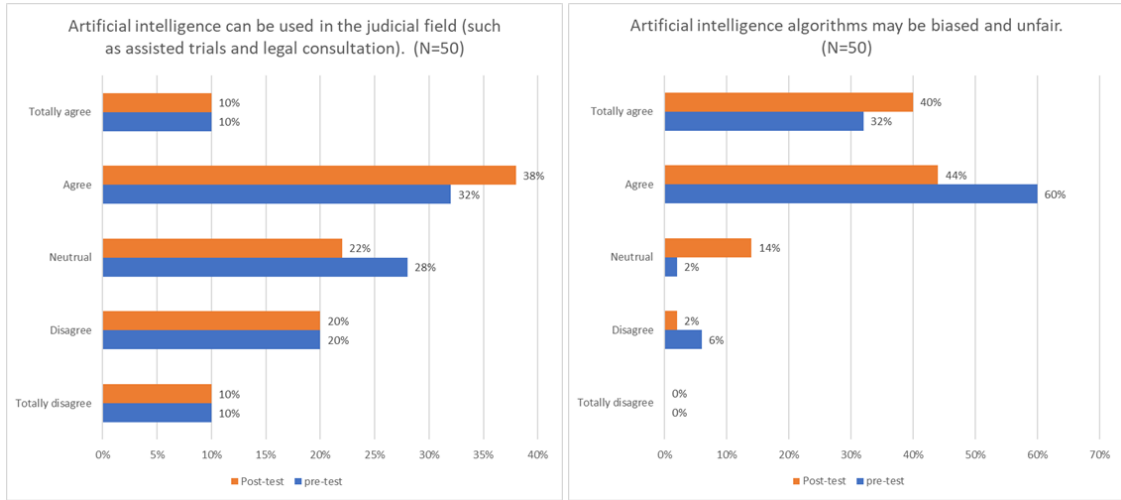


Figure 8: pre-test and post-test differences of Q1 "Artificial Intelligence can be used in the judicial field"

Figure 9: pre-test and post-test differences of Q2 "Artificial intelligence algorithms may be biased and unfair"

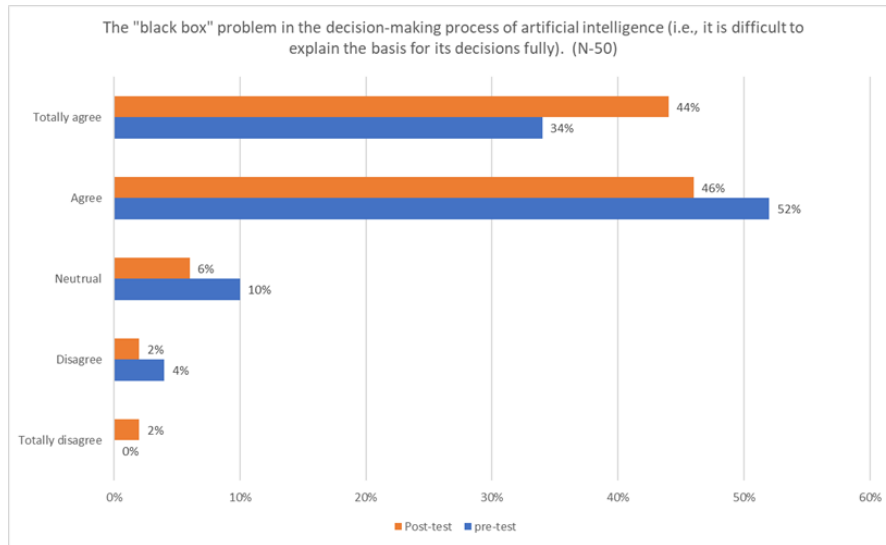


Figure 10: pre-test and post-test differences of Q3 "The 'black box' problem in the decision-making process of artificial intelligence (i.e., it is difficult to explain the basis for its decisions fully)."

Figure 9 shows the differences for the second knowledge question: Artificial intelligence algorithms may be biased and unfair. The data shows that respondents' per-

ceptions became more complex after reading the comic. While the percentage who chose "strongly agree" increased from 32% in the pre-test to 40%, indicating that the comic effectively deepened the beliefs of some audiences, it's worth noting that the percentage who chose "neutral" also rose from 2% to 14%. This phenomenon may indicate that the comic's more complex explanation of this knowledge point has led some readers to become more cautious after exposure to the comic.

Figure 10 provides the differences for the knowledge point "The 'black box' problem in the decision-making process of artificial intelligence (i.e., it is difficult to explain the basis for its decisions fully)". After reading the comic, the percentage of respondents who chose "strongly agree" increased from 34% in the pre-test to 44%. In contrast, those who chose "neutral" and "disagree" decreased by 4% and 2%, respectively. This powerfully demonstrates the comic's successful communication of this complex concept. However, it is noteworthy that one respondent chose "strongly disagree" in the post-test. This small change may indicate that for a tiny number of viewers, the comic's revelation of the "black box" issue may have deepened their confusion and led to a negative shift in their perceptions.

4.3 Observational changes in public attitudes toward the risks of AI

This section aims to evaluate the effectiveness of the comic in influencing the audience's attitudes and perceptions about AI risks through quantitative analysis.

Figure 11 uses a Sankey diagram to show the changes in the mean scores of all participants on the four attitude questions. Similar to the knowledge scores, this figure also reveals a more complex picture than the overall mean score changes.

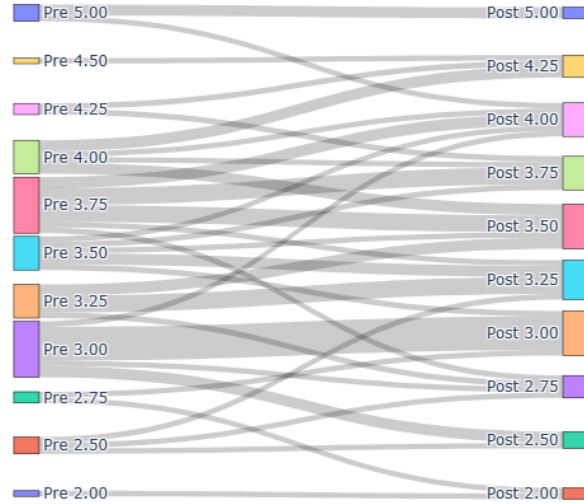


Figure 11: Changes in the pre-test and post-test mean scores of the four attitude questions

Compared to their knowledge scores, participants' attitudes showed more complex and diverse changes. Among all participants, 22 had their attitude scores improve, 11 had their scores remain the same, and 17 had their scores decrease.

From this data, we can see that the comic's impact on audience attitudes did not change in a single direction. Some audiences with higher initial scores became more cautious, others with lower initial scores became more moderate, and some have maintained the same attitude.

Individual problem analysis

Figures 12 to 15 show the differences in the Likert scale distributions for the four questions in the attitude part between the pre-test and post-test.

Regarding the question "Artificial intelligence can improve the efficiency and fairness of the judicial system", the data in Figure 12 shows that respondents' attitudes became more cautious after reading the comic. Before reading the comic, the average score for this question was 3.28. After reading the comic, the score dropped

to 3.24. 48% of respondents agreed or completely agreed before reading the comic, but after reading it, this percentage dropped to 40%. Meanwhile, the neutral attitude percentage increased from 26% to 42%. Meanwhile, the percentage who disagreed or completely disagreed also dropped from 26% to 12%. This suggests that by revealing AI systems' potential bias and unfairness, the comic successfully persuaded some respondents, who had previously held positive or negative attitudes toward AI, to shift to a more neutral or skeptical stance.

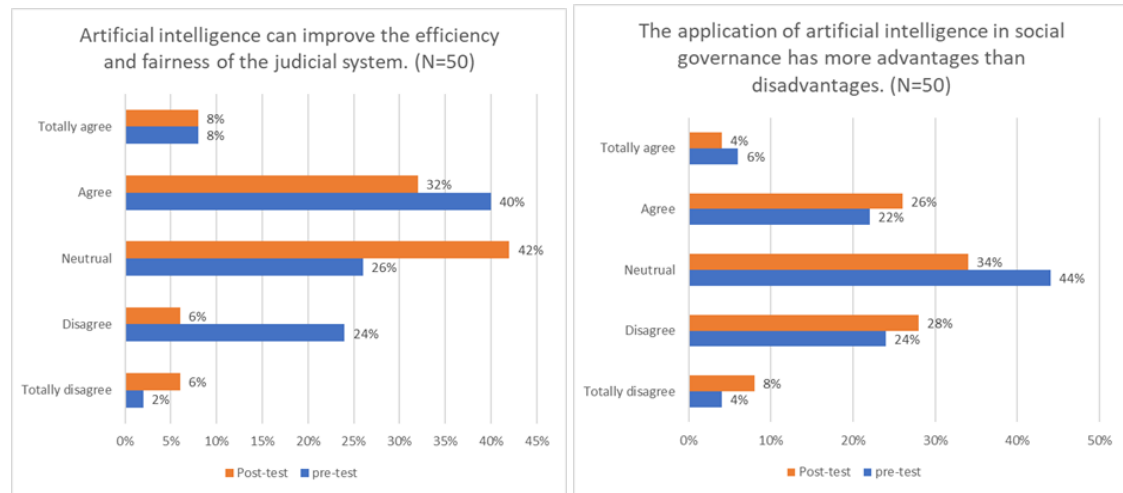


Figure 12: pre-test and post-test differences of Q4 "Artificial intelligence can improve the efficiency and fairness of the judicial system."

Figure 13: pre-test and post-test differences of Q5 "The application of artificial intelligence in social governance has more advantages than disadvantages."

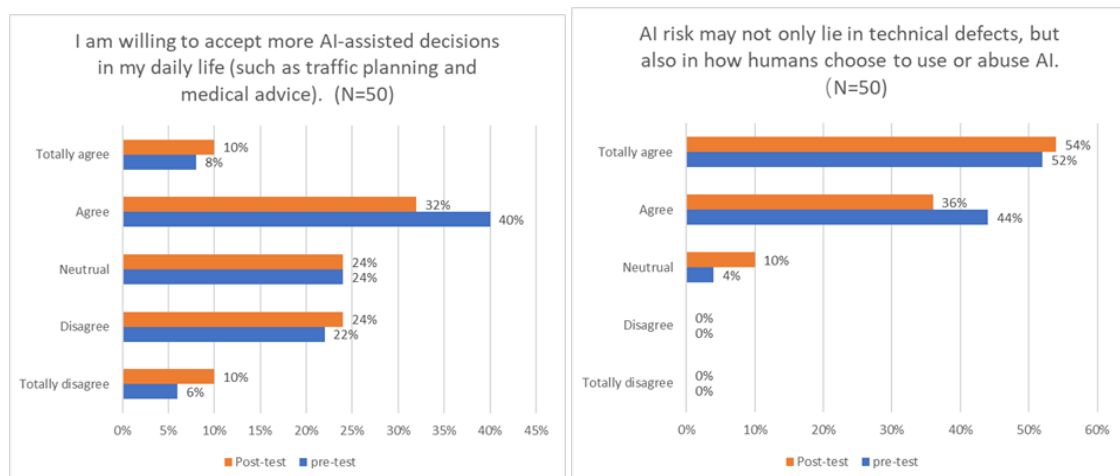


Figure 14: pre-test and post-test differences of Q6 "I am willing to accept more AI-assisted decisions in my daily life (such as traffic planning and medical advice)." Figure 15: pre-test and post-test differences of Q7 "AI risk may not only lie in technical defects, but also in how humans choose to use or abuse AI."

Regarding the question of "Application of artificial intelligence in social governance has more advantages than disadvantages", the average score in the pre-test was 3.02, but after reading the comic, the average score dropped to 2.90. Overall, the comic had a negative impact on participants' attitudes towards this issue. According to the data in Figure 6, the number of people who held neutral or agreed attitudes in the post-test decreased, while the proportion who chose to disagree or completely disagree increased from 28% to 36%. This shows that the comic successfully emphasized the potential risks of AI in social governance, making participants more cautious about this aspect, and even disagreeing.

Regarding the question "I am willing to accept more AI-assisted decisions in my daily life (such as traffic planning and medical advice).", the results in Figure 14 showed that the comic had a negative impact on the participants' willingness to accept it. The average score in the pre-test was 3.22, and in the post-test it dropped to 3.08. The percentage of people who agreed decreased from 48% to 42%, while the percentage of people who disagreed increased from 28% to 34%. This finding suggests that audiences' willingness to accept AI-assisted decision-making decreases when the comic reveals the potential risks of AI-assisted decision-making in their daily lives.

Figure 15 shows that the comic effectively deepened respondents' understanding of the question, "AI risk may not only lie in technical defects, but also in how humans choose to use or abuse AI." The average score was 4.48 in the pre-test and 4.44 in the post-test, showing little change. This result is consistent with the data distribution: before reading the comic, agreement on this question was already very high (96%), and the comic's primary role was to reinforce this consensus. This suggests that the comic primarily reinforced and confirmed a widely shared view among the audience.

4.4 Does the comic have communication effectiveness?

Table 2 shows the mean scores and the standard deviation of the two questions in the communication effectiveness part, which were set to assess the impact of the comic directly. **Q1** is "After reading the comic, I now know more about the risks of AI." **Q2** is "After reading the comic, I want to know more about the risks of AI."

Question (n)	Mean score	SD
Q1 (50)	3.84	1.01
Q2 (50)	3.82	1.07

Table 2: Results of the Communication Effectiveness section

Regarding the question "After reading the comic, I now know more about the risks of AI," the average score was 3.84 (SD = 1.01). Above the median of 3 on the Likert scale, this score strongly suggests that most respondents believe they have gained new knowledge about AI risks from reading the comic. Furthermore, the low standard deviation (1.01) indicates a high degree of consistency among respondents, who generally agree that the comic impart knowledge effectively.

Similarly, on the question "After reading the comic, I hope to learn more about the risks of AI," respondents scored an average of 3.82 (SD = 1.07). This score suggests that the comic successfully conveyed its message and, more importantly, sparked interest and willingness in the audience to explore the topic further.

4.5 Subgroup analysis

This chapter will conduct a subgroup analysis of the knowledge data, examining it from three dimensions: English proficiency, educational background, and age, to further explore the specific impact of comics on different audience groups.

4.5.1 Subgroup analysis by English proficiency

The research grouped the participants by their English proficiency and compared the pre- and post-test mean scores and standard deviations of the knowledge questions for each group. Table 3 shows the pre- and post-test mean scores, standard deviations, t and p -value of the knowledge questions for the different English proficiency groups. The results showed that all subgroups' pre-test and post-test differences were insignificant ($p > .05$).

Group (n)	pre- mean (SD)	post- mean (SD)	t	p-value
Beginner/Intermediate (12)	3.45 (0.71)	3.61 (0.58)	0.671	0.516
Advanced (34)	3.92 (0.46)	3.99 (0.51)	1.228	0.228
Native (5)	4.00 (0.47)	3.93 (0.36)	0.393	0.714

Table 3: Knowledge results for different English proficiency group

Beginner/Intermediate Level (12 participants): This group's pre-test mean score was 3.45 (SD = 0.71), the lowest of all groups. However, after reading the comic, their mean score rose to 3.61 (SD = 0.58), an increase of 0.16. Although this increase was not statistically significant ($t = 0.671$, $p = 0.516$), this group experienced the largest improvement in mean score. Furthermore, the decrease in standard deviation (from 0.71 to 0.58) suggests that the comic may have helped this group develop a more consistent understanding of complex concepts despite the non-significant increase in knowledge. This result suggests that the comic, as a visual medium, may positively impact conveying complex information to audiences with relatively low English proficiency.

Advanced Level (34 participants): This group of participants demonstrated a relatively high mean score (3.93, SD = 0.46) in the pre-test, indicating a pre-existing understanding and foundation of the knowledge conveyed by the comic. After reading the comic, their mean score rose slightly to 3.99 (SD = 0.51), though

the standard deviation increased slightly (by 0.05). This change was also statistically insignificant ($t = 1.228$, $p = 0.228$). The slight increase in the standard deviation may indicate that for this audience, the comic not only reinforces existing knowledge but also introduces new dimensions of thinking, leading to a slight divergence of opinions.

Native speakers (5 participants): This group had the highest mean pre-test score (4.00, $SD = 0.47$). After reading the comic, their mean score dropped slightly to 3.93 ($SD = 0.36$). Although the sample size was small and the difference was not significant ($t = 0.393$, $p = 0.714$), this trend is worth noting. The decrease in mean score and the reduction in standard deviation may indicate that the complexity or potential risks of AI revealed in the comic prompted some native speakers to become more cautious, shifting their views from their initial high confidence level to a more unified and rigorous stance.

This subgroup analysis reveals differences in the comic’s effectiveness across English proficiency levels. Although the statistical evidence that the comic significantly improved knowledge in any group was not found, descriptive data revealed some positive trends. Despite being written in English, the comic showed the greatest observed effect in improving knowledge among audiences with lower English proficiency. This suggests that the comic, as a visual medium, has the potential to transcend language barriers and promote the dissemination of scientific knowledge. Furthermore, it helps consolidate and refine knowledge among audiences with higher English proficiency.

4.5.2 Subgroup analysis by educational background

Table 4 provides the mean scores, standard deviations, t and p -value of pre- and post-test results for different educational background groups. The results showed that all subgroups’ pre-test and post-test differences were not statistically significant ($p > .05$).

Group (n)	pre- mean (SD)	post- mean (SD)	t	p-value
Computer science (15)	4.02 (0.79)	4.09 (0.57)	0.383	0.707
Law (7)	3.71 (0.44)	3.76 (0.50)	0.349	0.739
Neither (28)	3.72 (0.67)	3.82 (0.51)	1.162	0.255

Table 4: Knowledge results for different educational background groups

Computer Science Background Group (15 participants): This group had the highest mean score of 4.02 (SD = 0.79) in the pre-test, indicating a relatively deep understanding of AI risks. After reading the comic, their mean score rose slightly to 4.09 (SD = 0.56). Although this change was not statistically significant ($t = 0.383$, $p = 0.707$), the reduction in standard deviation indicated that the comic effectively reinforced their prior knowledge and led to a higher degree of coherence in their cognition.

Legal Background Group (7 participants): This group’s pre-test mean score was 3.71 (SD = 0.44). After reading the comic, the mean score rose slightly to 3.76 (SD = 0.49). This change was also insignificant ($t = 0.349$, $p = 0.739$). The slight increase in the standard deviation may suggest that the comic’s revelation of AI’s specific applications and risks in the legal field prompted more complex thinking, leading to a slight divergence in opinions.

Non-computer science nor legal background group (28 participants): This group’s pre-test mean score was 3.72 (SD = 0.67). After reading the comic, their mean score increased to 3.82 (SD = 0.59), representing the largest improvement (+0.10). Although this change was not statistically significant ($t = 1.162$, $p = 0.255$), this group’s t value (1.162) was the highest among all educational background subgroups, indicating that the comic had the strongest impact on their knowledge. Furthermore, the reduction in standard deviation suggests that the comic enhanced their knowledge and focused their cognition.

This subgroup analysis highlights the comic’s differentiated impact across audiences with different educational backgrounds. Although lacking statistical significance, it showed the strongest trend of knowledge improvement among non-professional audiences, confirming the comic’s powerful ability to popularize science.

4.5.3 Subgroup analysis by age

In order to explore whether the age of the audience affects the dissemination effect of the comic, the participants were grouped according to age, and the mean scores, standard deviations, t and p -value of pre- and post-test results on knowledge questions of each group were compared. Table 5 shows the results for different age groups. It should be noted that since there is only one person over 50 years old,

this data is merged into the 40-49 age group, so this group represents the age group over 40 years old.

Group (n)	pre- mean (SD)	post- mean (SD)	t	p-value
20-29 (32)	3.70 (0.58)	3.78 (0.53)	0.818	0.420
30-39 (13)	3.95 (0.40)	4.03 (0.46)	0.719	0.486
40 and above (5)	4.20 (0.61)	4.27 (0.59)	0.557	0.607

Table 5: Knowledge results for different age groups

20-29 Years Old Group (32 participants): This group had a mean score of 3.70 (SD = 0.58) on the pre-test, making it the largest sample size of all groups. After reading the comic, their mean score rose to 3.78 (SD = 0.52), an increase of 0.08, with a decrease in the standard deviation. Although this change was not significant ($t = 0.818$, $p = 0.420$), the t -value for this group (0.818) was the highest among all age subgroups, indicating that the comic has the strongest positive impact trend among this largest audience group. The reduction in standard deviation also suggests that the comic enhanced their knowledge and led to greater cognitive consistency.

30-39 Years Old Group (13 participants): This group’s pre-test mean score was 3.95 (SD = 0.40). After reading the comic, their mean score rose to 4.03 (SD = 0.46). This change was insignificant ($t = 0.719$, $p = 0.486$). This group’s mean score increased by the same amount as the 20-29 age group, but differed from the 20-29 age group in that their standard deviation increased slightly. This may mean that while improving knowledge, the comic also prompts more complex or diverse thinking among this age group, leading to a slight divergence in opinion.

40+ Group (5 participants): This group exhibited the highest mean score in the pre-test, at 4.20 (SD = 0.61). After reading the comic, their mean score rose slightly, to 4.27 (SD = 0.59). This trend was not significant ($t = 0.557$, $p = 0.607$), and it suggests that for older audiences with higher initial knowledge levels, the comic may have served to consolidate and refine their knowledge, building on their existing understanding and gaining a deeper understanding of AI risks. The slight decrease in the standard deviation also reflects that their knowledge has become more focused after the comic’s influence.

This subgroup analysis shows that the comic positively impacts knowledge en-

hancement among young and middle-aged audiences while contributing to a more consistent understanding. Although none of the results reached statistical significance, the comic showed a positive trend in knowledge enhancement among young and middle-aged audiences, while also helping older, more knowledgeable audiences consolidate and deepen their understanding.

5 Discussion

This chapter will reflect on the research, focusing on methodological and design limitations, and based on these considerations, propose prospects for future work.

5.1 Limitations and Reflection

This study aimed to explore how to create a dystopian science comic that communicates complex AI trust issues to the public and to evaluate its impact. While this study yielded some meaningful findings, its design and implementation limitations warrant further reflection. These limitations may have impacted the overall significance of the findings and provided valuable insights into the question of effective communication.

First, the comic’s design may have structural issues. While it received many positive reviews, some participants informally reported that the excessive text reduced their interest in reading. This suggests that, while pursuing a complete storyline and plot depth, the comic may have sacrificed the lightweight and accessible nature of some science comics. The comic often relies on long paragraphs of text explanation rather than pure visual narrative when addressing complex concepts, such as AI bias and the "black box" problem. This directly led some readers to perceive the text as excessive, and also explains the modest improvement in knowledge scores between the pre-test and post-test. This suggests that future comics should better balance narrative depth and intuitive knowledge communication.

Second, while this study provides valuable insights, a key methodological improvement for future research would be the inclusion of a control group. Unlike studies such as Lin et al. [2014] and Wayne et al. [2024], which used control groups to compare the effects of comics with other media (e.g., plain text, academic articles), this study’s design choices were primarily driven by time and resource constraints. Including a control group would be a crucial next step to more rigorously assess

the unique value of science comics as a communication tool.

Finally, this study had a small sample size ($N=50$) and only conducted a single round of experiments, leaving no opportunity for refinement and re-experimentation based on the initial results. This was due to time constraints, with only one week to distribute the questionnaire. The small sample size limited the study's statistical power, making it difficult to confirm any real effects statistically.

5.2 Future work

Based on the above reflections, future research could improve and expand upon the following areas to more deeply answer the core questions of "how" and "influence":

- **Optimizing comic design:** To address the issues of excessive text and poor integration of knowledge points in comics, future research could explore improving the design of storylines and knowledge point explanations. New versions should prioritize the synergy between images and text, using more creative visual language to explain abstract concepts and reduce the textual burden. For example, a series of visual illustrations could demonstrate how algorithms learn from biased data, rather than lengthy text explanations.
- **Adding control groups:** Future research should include a control group, comparing the comic group with a text-only group, a summary group, or a no-intervention group, to more rigorously quantitatively evaluate the unique advantages and effectiveness of this particular style of comics as a communication medium.
- **Increasing sample size and conducting multiple rounds of experiments:** Future research should strive to increase sample size to improve statistical power. Furthermore, multiple rounds of experiments could be considered. For example, after the first round of experiments, the comic could be optimized based on feedback, and the effectiveness of the improvements could be reassessed in a second round, followed by multiple rounds of experiments based on feedback.
- **Long-term impact assessment:** This study only assessed the short-term impact of the comic. Future research could design longer-term follow-up surveys to determine the long-term effects of the comic on audience knowledge and attitudes, and whether they can sustainably stimulate audience attention and engagement on relevant issues.

6 Conclusion

This study explored whether science comics, using a created dystopian comic as a medium, can effectively enhance public understanding and attitudes regarding AI trustworthiness. Through quantitative analysis of pre- and post-test data, this study found that while the overall effect of the comic intervention did not reach statistical significance, it produced complex and meaningful impacts across multiple dimensions. These findings suggest that comics as a communication tool may serve not only to transfer knowledge but also to influence how audiences reflect on and assess the risks of AI.

At the knowledge assessment level, the average score showed a rise from 3.81 to 3.89 ($p = 0.264$), which suggested a non-significant but marginally positive change. Of the 50 participants, 23 improved, 16 reduced, and 11 remained the same in their scores. More nuanced analysis at the topic level revealed that the comic conveyed the "black box problem" very well since the proportion of strong agreement increased from 34% to 44%. However, when the topic concerned "algorithmic bias," the response tended to be polarized such that some participants developed greater clarity while the remainder became more uncertain.

At the attitude level, the direction of change in the survey was just as varied: 22 participants' attitudinal scores rose, 17 fell, and 11 remained the same. Detailed questions showed decreased agreement among some individuals in the statements "AI improves judicial efficiency" and "social governance benefits outweigh risks," indicating a more cautious view. Disagreement in the statement "willingness to accept AI-assisted decision-making" rose. Regarding the statement "risks stem not only from technical flaws but also from human use," the comic mostly reinforced prevailing consensus. Overall, the comic did not induce a homogeneous change in knowledge and attitudes but evoked variegated and differentiated reactions.

The participants' direct feedback regarding the comic was crucial in the context of the comic's communicative effectiveness. The participants scored an average of 3.84, meaning most felt they "learned more about AI risks." Additionally, the participants' average score of 3.82 implies that the comic increased their interest in further exploring related topics. These results indicate that while the change to knowledge and attitudes immediately was small-scale, the comic could foster public learning.

Subgroup analysis in this work showed that the lower English competency and the non-computer science and legal education subgroups exhibited a stronger tendency to knowledge advancement. Although such movement failed to be statisti-

cally significant, the finding implies that comics, a mainly pictorial communication medium, may be better at cross-lingual and cross-disciplinary communication.

However, the current study has limitations, such as a small sample size, the absence of a control condition, and possible text density-related issues in the comic design. These limitations provide valuable guidance for future research. For future research, it would be useful to develop optimized comics that better balance the complexity of narrative and the immediacy of the visible. Larger-scale multi-round experiments using control conditions may also be conducted to test the communicative effectiveness of comics more rigorously.

In sum, this study’s findings demonstrate that science comics do not represent a shortcut to appreciable knowledge supplementation or attitudinal change in the very short term. Yet science comics potentially help stimulate interest, encourage audiences to think more critically about the risk of technology, and bring complexity to bear among non-expert audiences. Future research could more seriously explore whether the trends observed translate to long-term and sustained communication impacts using larger sample sizes, control groups, and multiple iterations at the experimental level.

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A Survey Questionnaire

A.1 Part I: Consent and Basic Information

A.1.1 1. Informed Consent

This study is being conducted as part of a MSc thesis project performed at LI-ACS, Leiden University. The lead scientist is Xiaolu Yi, a MSc student, under supervision of Faculty staff at the University.

If you have any questions about this study, you may contact Xiaolu Yi through the following email address: x.yi.2@umail.leidenuniv.nl.

The aim of this thesis project is to inform society about important societal implications of recent developments in Artificial Intelligence, and what are effective communication strategies to inform the general public. The answers collected in this study will be used to evaluate the effectiveness of comics to meet these goals.

Your answers will not be used for other purposes or shared with third parties. Results of the questionnaire will be published in aggregated format in the thesis (e.g., “75% of the participants found the comic useful”), and in no way linkable to you as a person.

The answers collected in this study will be completely anonymous. Participation in this study is completely voluntary. You may stop participating at any time.

I declare that I have read and understood the above information and allow the researcher to store, analyze, and report the aggregated and anonymous results.

☐ Yes

☐ No

A.1.2 2. Demographics

What is your age? (Open field, checks for numeric input) _____

What is your current academic degree?ongoing education

- ☐ Undergraduate student
- ☐ Master student
- ☐ PhD student
- ☐ Other (please specify: _____)

Do you have a background in computer science or law?

- ☐ Yes, in computer science.
- ☐ Yes, in law.
- ☐ Yes, in both.
- ☐ No

A.2 Part 2&3: Knowledge and attitudes

Please rate your degree of agreement with the following statements before reading the comic (1 = totally disagree, 5 = totally agree):

A.2.1 1. Knowledge about AI and legal

Artificial intelligence can be used in the judicial field (such as assisted trials and legal consultation).

Artificial intelligence algorithms may be biased and unfair.

The "black box" problem in the decision-making process of artificial intelligence (i.e., it is difficult to explain the basis for its decisions fully).

A.2.2 2. Attitudes on AI and the law

Artificial intelligence can improve the efficiency and fairness of the judicial system.

The application of artificial intelligence in social governance has more advantages than disadvantages.

I am willing to accept more AI-assisted decisions in my daily life (such as traffic planning and medical advice).

AI risk may not only lie in technical defects, but also in how humans choose to use or abuse AI.

A.3 Part 4: Knowledge and attitude after watching the comic

Instructions: Please answer the following questions after reading the comic.

After reading the comic, I now know more about the risks of AI. (1 = Totally disagree, 5 = Totally agree)

After reading the comic, I want to know more about the risks of AI. (1 = Totally disagree, 5 = Totally agree)

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