

Technological Tools for AI-Based Science Popularization Services: Innovation, Risks, and Countermeasures

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Abstract: Artificial intelligence is leading an unprecedented revolution in technological tools and driving full-process innovation in science popularization services. As tools for inspiration stimulation, content generation, round-the-clock quality control, scene construction, positioning, data collection, and data processing, AI has reshaped the models of science popularization creation, review, dissemination, and evaluation, greatly improving the efficiency, quality, breadth, precision, and scientific rigor of science popularization services. However, owing to the limitations of technological tools, risks such as groundless "hallucinations" have followed close behind: they may strike at the authority and agency of science popularization personnel, erode the very foundation of science popularization services, and hamper efforts to strengthen value guidance in science popularization services. For this reason, in the process of delivering science popularization services, it is necessary to enhance science popularization personnel's understanding of and ability to use AI, regulate the boundaries of AI application, and endow AI with connotations of value rationality on top of technical rationality.

Keywords: artificial intelligence; science popularization; technological tools

1 Introduction

Since the launch of ChatGPT in November 2022, large artificial intelligence (AI) models have sprung up one after another, once again triggering extensive public discussion about artificial intelligence. Public attitudes toward AI are complex, encompassing both expectation and recognition as well as concern and unease [1]. Nevertheless, most members of the public hold a rational attitude toward AI: a survey conducted by the People's Think Tank shows that most respondents agree that the development of a new generation of AI should be accelerated while, at the same time, the assessment and prevention of potential risks should be strengthened [2]. If we broaden our perspective and place AI within the entire history of human civilization, we find that AI—like the stone tools of tens of thousands of years ago, the iron tools of thousands of years ago, and the machines of hundreds of years ago—is a typical labor tool created by humanity in the course of continuous development to transform its relationship with nature. Today we are experiencing an unprecedented revolution in technological tools [3].

As a kind of “knowledge-disseminating behavior,” science popularization services have always changed in form along with changes in technological tools. Taking popular science books as an example, the development of convergent media technology has transformed popular science books, which previously offered only one-way visual intake, into a system of science popularization reading texts that is now composed jointly of text, images, animation, and audio and video and that can be experienced through multiple senses [4]. In the new era, science popularization services, as foundational work for achieving innovative development, have been entrusted with the new mission of “serving people’s all-round development, serving innovative development, serving the modernization of the national governance system and governance capacity, and serving the building of a community with a shared future for mankind” [5], and have become an important means of consolidating the scientific foundation of the great rejuvenation of the Chinese nation [6]. There is an urgent need to comprehensively improve their quality and level. The new revolution in technological tools triggered by AI provides a tremendous opportunity for promoting the

comprehensive renewal of science popularization services.

At present, research on the relationship between AI and science popularization mainly focuses on how science popularization can play a role in eliminating public panic about intelligent technology [7], and on the models, dimensions, problems, and countermeasures of popularizing intelligent technology to the public [8]. Relatively little attention has been paid to the influence of AI on science popularization services themselves. From the perspective of technological tools, this paper elaborates in detail on the ways and advantages through which AI tools drive full-process innovation in science popularization services, sorts out the associated risks, and discusses relevant countermeasures and suggestions, so as to provide new ideas for promoting the comprehensive renewal of science popularization services.

2 The Tool Attributes of Artificial Intelligence

Artificial Intelligence (AI) is an emerging technological science that studies and develops theories, methods, technologies, and application systems for simulating, extending, and expanding human intelligence, with the aim of enabling machines to possess learning abilities and behavioral performance similar to those of humans, such as human-like thinking, human-like behavior, rational thinking, and rational behavior [9]. Since it was first proposed in 1956, and following decades of tortuous development as well as major breakthroughs in technologies such as natural language processing, computer vision, and deep learning, AI's simulation of human intelligence has become increasingly realistic, and it appears to have the potential to challenge human subjectivity. In essence, however, it remains a technological tool.

Andrew Feenberg argues that technological tools possess two characteristics: “human control” and “value neutrality” [10]. “Human control” reflects the relationship between technology and humans, indicating that humans hold control over technology. “Value neutrality” reflects the relationship between technology and value, and its connotations include the following: first, with respect to technology itself, technology has no value attributes and cannot be divided into good or bad; second, with respect to the consequences of using technology that may embody value, technology is passive—it has no inclination toward the consequences of use, and its value-related connection with any consequence of use is accidental; third, as a special case of the preceding point, technology does not favor any different consequences that embody opposing values [11].

In the field of AI technology, both Ray Kurzweil and David J. Chalmers believe that AI has a technological singularity, which has triggered extensive discussion about the ethics of AI technology [12-13]. The technological singularity theory predicts that when a certain critical point is reached, AI will acquire autonomous consciousness and may therefore escape human control. In reality, however, although the in-depth development of pre-trained large model technology has enabled AI to demonstrate a certain capacity for logical proof and comprehension [14], this does not mean that AI has already acquired thought and consciousness, reached the technological singularity, and thus transcended the category of technological tools [12]. Of course, some scholars hold a different view, believing that it is only a matter of time before AI develops autonomous consciousness and that AI has the potential to become a technological subject. For example, some legal experts argue that, driven by autonomous consciousness, strong AI may commit “criminal acts” outside the scope of programs designed and formulated by humans. This resembles the situation in which an ordinary person with criminal responsibility commits a criminal act, and therefore consideration should be given to granting strong AI the status of a subject of criminal responsibility [15].

The above discussion of AI as a technological tool applies broadly across various fields. Likewise, in the field of science popularization services, AI brings technological innovation while also prompting people to think seriously about the ethical issues it raises. On the whole, however, given that the application of AI in the field of science popularization is still relatively new, what it currently brings to science popularization services is more a matter of innovation.

3 AI Tools Driving Innovation in Science Popularization Services

At present, AI, as a labor tool, has driven major transformations in the fields of education and communication, which are closely related to science popularization. In the field of education, AI helps build platforms that aggregate educational resources, promotes the dissemination and sharing of educational resources, and facilitates the upgrading of teaching models, learning methods, and evaluation models [16]. For example, as a tool for setting examination questions and grading homework [17], AI can save teachers a great deal of time and energy and reduce their pressure and burden; however, the generation of examination questions and the criteria for judging answers are still determined by teachers, who hold the initiative in this process. Research shows that when AI tools are used to assist in grading test papers in teachers' actual teaching and skills competitions, the time required for grading 40 papers can be compressed from 3-4 hours to 30-40 minutes [18]. In the field of communication, AI, as a tool for information collection, production, integration, and distribution [19], plays a role in processes such as information retrieval and classification and personalized recommendation, helping people obtain the information they need accurately and efficiently. For example, the “intelligent creative robot” launched by the Smart Media Research Institute of People's Daily can help journalists independently complete tasks such as interviews, filming, analysis of news materials, and content creation [20]. In this process, the actions taken by AI are still based on human instructions.

In the field of science popularization, some science and technology museums have developed intelligent voice guide systems. Visitors need only wear earphones and, without any operation, walk into a sensor-triggered commentary area to immediately enjoy live commentary pre-recorded by relevant personnel. As a science popularization commentary tool, AI has already shown great application potential in this field. Given the powerful functions that AI currently demonstrates, it also has the potential to fulfill the attributes of tools with different functions in the creation, review, dissemination, and evaluation of science popularization services, which will help drive full-process innovation in science popularization services and reveal unprecedented technological advantages.

3.1 AI Tools Empowering Full-Process Innovation in Science Popularization Services

3.1.1 Creation: Tools for Inspiration and Content Generation

Practical experience shows that the application of AI in science popularization creation is mainly concentrated in two stages: preparation before creation and the process of creation, in which it functions as a tool for inspiration and a tool for content generation, respectively.

In the preparation stage before science popularization creation, AI can be used to analyze historical data on massive numbers of science popularization works—including themes, genres, creating institutions, sales, and audience satisfaction—so as to summarize popular science popularization subjects and forms, help creators determine the direction of creation, and stimulate their creative inspiration. Science popularization creators can use large language models for tasks such as brainstorming and drafting text outlines. During the creation process, creators can also use AI to generate science popularization content, including multimodal content such as text, images, and videos. With the continuous improvement of the capabilities of generative AI such as ChatGPT-like models and Sora, its use as a tool for generating science popularization content has become easier for people to adopt. In June 2024, Yang Wenzhi and others published the book *Large Models: My Assistant for Science Popularization Creation*, which explains in detail the basic principles and practical methods for creating popular science articles, speeches, and commentary scripts with the help of AI [21].

In the process of using AI for science popularization creation, creators actively give play to their subjective initiative. They issue instructions to AI through high-quality “prompts,” and AI produces the results the creators want according to those instructions; the creators remain the subject of science popularization creation. How creators design high-quality “prompts” and interact with AI to advance creation will become a new challenge for science popularization creation. High-quality “prompts” need to be explicit, targeted, and creative so that AI can understand

the creator's intentions and needs more accurately. For example, when a creator wishes to generate a popular science article about space exploration, prompts containing keywords such as "black holes," "dark matter," and "interstellar travel" can be designed to guide AI to generate science popularization content related to these concepts. In addition, creators can further refine the content generated by AI by providing specific requirements regarding style, tone, or structure, making it better suited to the positioning of a particular science popularization work.

In practice, creators can make use of the iterative learning function of AI to continuously optimize the design of "prompts." Through repeated experimentation and adjustment, creators can find the most appropriate combination of prompts, thereby guiding AI to generate higher-quality science popularization content. For example, if the initially generated content fails to accurately reflect the intended science popularization topic, the creator can fine-tune the prompt by adding or replacing certain keywords in order to achieve a better result.

Moreover, the application of AI in science popularization creation is not limited to the generation of textual content. Through combination with multimedia technology, AI can also assist creators in producing science popularization works that contain rich visual elements. For example, images or video clips generated by AI can intuitively display scientific concepts or experimental processes, providing readers with a more vivid learning experience.

3.1.2 Review: Round-the-Clock Quality Control Tools

In the review of science popularization content, AI, with its advantages of high speed and high efficiency, plays an important role as a round-the-clock quality control tool.

Using technologies such as natural language processing, computer vision, and deep learning, AI extracts segments of text, speech, and images from science popularization works and identifies them according to AI algorithm rules, screening out rumors and undesirable content such as pornography and violence in science popularization content, so as to safeguard its scientific validity and authority. The key to this process is that humans establish review standards and formulate algorithms for identifying and filtering sensitive words. The application of relevant technologies in some fields is already relatively mature. For example, when releasing science popularization information in the aerospace field, a large model for confidentiality review based on intelligent technologies such as optical character recognition (OCR) and natural language processing (NLP) can be used. Following steps such as sensitive word identification, contextual content analysis, and risk assessment, it improves the efficiency and accuracy of reviewing classified information [22]. The Archives of Fujian Province developed and built an "AI-based system for the open review of archival records based on digital archives," which increased the efficiency of open review work by more than three times [23].

Tencent has already used AI to assist in reviewing content on WeChat official accounts, and ByteDance has also developed an AI review system for short videos and live-streaming content. Accordingly, platforms such as WeChat, Douyin, and Kuaishou have used AI to review science popularization content, conducting automated review by loading intelligent detection and filtering systems [24]. Quora, a knowledge and information dissemination platform often described as the American counterpart of Zhihu, has also trained AI to identify false information and other information through a training label dataset composed of 1.3 million questions [25].

3.1.3 Dissemination: Scene Construction and Positioning Tools

In the dissemination of science popularization content, AI, with its advantages of high efficiency and precision, plays an important role as a tool for scene construction and positioning.

In the course of delivering science popularization services, personnel can use AI to construct an interactive, perceptible physical space that integrates the virtual and the real, and to create specific scenes within that space, making traditional science popularization content more vivid and intuitive and enhancing the effectiveness of science popularization services. For example, wearable intelligent devices such as AR and VR can be used to enhance the immersion of science popularization audiences in science popularization services, and virtual digital humans can be used to increase their interactivity. On April 24, 2021, China's Mars exploration program, together with Baidu,

released “Zhurong,” the world’s first digital human of a Mars rover, which served as a virtual host in multiple scenarios and popularized knowledge about Mars exploration for the public in a vivid and intuitive way.

As a positioning tool, AI also plays an important role in the dissemination of science popularization content. On the one hand, science popularization audiences can use AI for intelligent search to accurately retrieve and locate the science popularization content they need. On the other hand, science popularization personnel can use AI to analyze the information people search for and browse, discover the public’s individual preferences, and thereby customize dedicated science popularization content for them and deliver more precise science popularization services to the public. In this process, AI is used to break down the original barriers to information transmission, aggregate multimodal science popularization content, and build an intelligent dissemination matrix that integrates the cloud, the internet, and mobile terminals, thereby realizing all-media dissemination, satisfying people’s high-quality, immersive, and interactive science popularization needs, and improving the quality of science popularization services.

3.1.4 Evaluation: Data Collection and Processing Tools

In the evaluation of science popularization effectiveness, AI, with its advantages of being scientific, multidimensional, diverse, and precise, plays an important role as a tool for data collection, analysis, and visual presentation of results. First, evaluators can rely on technologies such as video surveillance, facial emotion recognition, behavior prediction, wearable devices, online review and grading, and IoT sensing, and, supported by automatic recording through data collection platforms and intelligent machines, collect various data across the whole process, in all directions, and at multiple levels, thereby achieving full-cycle tracking of users’ satisfaction with science popularization services and providing the most solid foundation for the accuracy of science popularization effectiveness evaluation. Then, with the help of technologies such as big data, cloud computing, expert systems, deep learning, and artificial neural networks, evaluators can construct more reasonable evaluation index systems and index weights for different evaluation objects, establish more scientific evaluation models, and conduct multimodal diagnosis and in-depth mining and analysis of the collected data. Finally, evaluators can use intelligent technologies to present the results of the analysis and processing of evaluation data in a visual and intelligent manner [26].

At present, there are already relatively mature cases of using AI to evaluate teaching effectiveness in the field of education. For example, Beijing Normal University has used AI to evaluate classroom teaching effectiveness and developed an innovative “AI+” intelligent classroom teaching evaluation tool. By integrating various AI and data analysis technologies such as computer vision, natural language processing, ensemble learning, and statistical modeling, it has built a comprehensive intelligent evaluation system for the classroom teaching process, which monitors, tracks, and analyzes in real time teachers’ and students’ behavior, concentration, emotions, gaze, and activity levels, and can review the entire teaching process, thereby accurately evaluating teaching effectiveness.

In the future development of science popularization creation, AI will play an increasingly important role. With the continuous advancement of technology, the auxiliary role of AI in content generation, review, dissemination, and evaluation will become more prominent. Creators need to continuously learn and master AI technologies in order to make full use of their potential in science popularization creation and drive innovation in science popularization services.

3.2 Advantages of AI Tools in Empowering Science Popularization Services

3.2.1 Human-Machine Collaboration Improves the Efficiency and Quality of Science Popularization Services

In the era of AI, AI, as an assistant in science popularization services and under the guidance of science popularization personnel, can maximize the efficiency of all links in science popularization services, including creation, review, dissemination, and evaluation.

In the process of science popularization creation, science popularization creators and AI form a community. A model of science popularization creation is taking shape in which the creators are responsible for thinking through the main viewpoints and making decisions and guide AI to produce polished texts [27], which greatly simplifies the

process of generating science popularization content. For example, general-purpose large models such as ChatGPT can also help science popularization creators collect materials and summarize and refine texts, accelerating the pace of science popularization creation. Science Popularization China (Kepu Zhongguo) and iFLYTEK jointly developed a dedicated science popularization cognitive large model, “AI Xiaoke,” which not only includes a “science popularization Q&A” module but is also an assistant for science popularization creation, including modules for “popular science article creation,” “short video script creation,” and “copywriting master,” effectively improving the efficiency of science popularization creation.

In the process of science popularization review, a “blacklist” of keywords is established in advance by science popularization personnel. Once review standards are established through AI algorithms, AI can automatically review science popularization content with only a small amount of manual intervention, greatly saving costs and improving efficiency. In addition, the use of AI for precise dissemination of science popularization resources and comprehensive collection of science popularization evaluation data mentioned above are also important manifestations of how human-machine collaboration improves the efficiency and quality of science popularization services.

3.2.2 Systematic Integration Expands the Breadth and Precision of Science Popularization Services

With the help of AI tools, information on various science popularization resources, personnel, and science popularization needs can be mined in depth and integrated systematically and effectively, thereby improving the precision and effectiveness of the supply of science popularization services.

On the one hand, AI can be used to integrate multimodal science popularization resources. With the rapid development of technologies such as natural language processing and computer vision, AI can aggregate high-quality science popularization resources in various forms, including text, audio, and video, helping to build an intelligent platform for aggregating digital science popularization resources. Because it is basically unrestricted by time and space, such a platform will enable high-quality and balanced science popularization resources to reach the public more effectively, effectively solving the problem of uneven science popularization services, bridging the differences that arise in the distribution of science popularization resources, making the downward transfer of science popularization resources more effective, and greatly improving the breadth and equality of science popularization resource transmission.

On the other hand, AI can be used to integrate information on the supply and demand of science popularization resources, promoting the precise matching of science popularization resources with demand. By analyzing and mining data on science popularization behavior—such as users' browsing behavior, interests, and preferences—AI can aggregate science popularization demand, help formulate personalized distribution strategies for science popularization resources, proactively allocate science popularization resources, and drive the precise delivery of science popularization resources.

3.2.3 Non-Interventional Approaches Enhance the Scientific Rigor of Science Popularization Services

With the help of AI tools, science popularization personnel can carry out non-interventional studies (NIS), obtain data on various science popularization services in an all-round way, and enhance the scientific rigor of science popularization services. A non-interventional study refers to exploring and analyzing problems through careful observation, detailed recording, and comprehensive analysis without changing the natural conditions or environment of the research subject; it is mainly characterized by its ability to reflect the true situation of the research subject, thereby avoiding bias or misleading results caused by external intervention. It is objective and flexible and is widely used in medical and sociological research. Non-interventional studies are usually divided into two categories: retrospective studies, which extract needed past data from a database for analysis, and prospective studies, which select specific subjects and then track and record relevant data for analysis.

As mentioned above, when science popularization personnel use AI for content review, precise dissemination, and evaluation, they rely on fixed algorithms as well as data collected through automatic recording by data collection

platforms and intelligent machines while subjects are in their natural state, which effectively avoids subjective human intervention. For example, in research evaluating the effectiveness of science popularization services, personnel can extract past data on research subjects from databases collected by AI for retrospective studies, or use AI to specifically track a particular subject for prospective studies, avoiding the influence caused by excessive human participation and greatly enhancing the scientific rigor of science popularization evaluation.

4 Risks and Countermeasures of Applying AI Tools to Science Popularization Services

4.1 Risks

While AI, as a tool, drives innovation in science popularization services, its risks also arise due to the limitations of technology, mainly manifested in human dependence on, worship of, and misuse of AI tools.

4.1.1 *Tool Dependence Undermines the Authority and Agency of Science Popularization Personnel*

Human dependence on tools has been evident since tools were created. In the process of human-machine collaboration in science popularization services, humans inevitably develop dependence on AI as well. From the perspective of science popularization personnel, when AI is widely used for science popularization creation, review, dissemination, or evaluation, algorithms will program everything as much as possible, including programmed choices, programmed decisions, and programmed information feedback. Under such circumstances, science popularization personnel will also become a certain link in a fixed procedure, and over time their abilities will become rigid or even deteriorate. From the perspective of the public, AI, based on its vast database and refined and complex algorithms, can directly provide the public with accurate and detailed science popularization information. After testing it again and again, the public can easily build up trust in AI.

As the capabilities of AI continue to strengthen and the capabilities of science popularization personnel become rigid or even deteriorate, the public's trust in AI will also continue to rise, until it exceeds their trust in humans. At that point, the authority of science popularization personnel will face severe challenges, and they will lose the initiative in delivering science popularization services. They will be captured and disciplined by technical rationality, consciously or unconsciously regard technical rationality as a natural law, and gradually become "appendages" of technology [28]. As Ursula M. Franklin emphasized in *The Real World of Technology*, the reshaping based on prescriptive technologies has greatly unleashed productive forces and improved efficiency, but the price is that workers thereby lose more autonomy [29].

4.1.2 *Technophilia and Misuse Erode the Foundations of Science Popularization Services*

At present, quite a few people are admirers of AI and believe that technology is omnipotent. They are fascinated by the intelligence, comprehensiveness, and efficiency of AI and regard it as the decisive factor and fundamental driving force for the development of science popularization. From an epistemological perspective, people's worship of technology is an important phenomenon of technological psychological response, the essence of which is to idealize, absolutize, or sanctify technology [28]. It cannot be denied that AI has played a tremendous role in enriching the ways in which science popularization content is disseminated and in promoting the fair and inclusive distribution of science popularization resources. This has also led many people, consciously or unconsciously, to become supporters of technology and to fall into the mire of "technological omnipotence." Intelligent science popularization infrastructure has also been built in various places. However, because the update and iteration speed of AI is increasingly fast, science popularization personnel have to repeatedly learn to operate different intelligent devices, becoming "captives" of technological iteration and targets "encircled" by capital, and it is easy for them to overlook the fundamental principle that science popularization services should be "people-centered."

In addition, "deep fake" technology developed on the basis of AI may undermine the foundation of the scientific validity of science popularization content. "Deep fake" usually refers to the use of AI to place a person's facial contours and expressions onto the face of any other person while also processing the voice realistically, creating

videos that appear authentic but are in fact synthesized, in order to evade identification, confuse the public, and achieve the purpose of false propaganda [30]. In this way, the difficulty of faking science popularization content is greatly reduced. Moreover, AI is inherently prone to “hallucinations” when producing science popularization content, forming plausible but misleading science popularization works. If AI tools are used without restraint, this will encourage the phenomenon of “using the name of science popularization to carry out pseudo-science popularization” and shake the foundations of science popularization services.

4.1.3 Technical Rationality Is Not Conducive to Strengthening Value Guidance in Science Popularization Services

The behavior of technical rationality (or instrumental rationality) pursues obtaining the maximum output with the minimum input, can provide quantitative explanations of things, and is characterized by strong precision and specificity [31]. However, it focuses only on whether the goal is achieved and not on the means and results of achieving it, which easily leads to undesirable consequences and a reversal of ends and means. The technicalization of science popularization will also inevitably strengthen the interaction between humans and machines, and science popularization personnel will tend to treat science popularization services as an assembly-line technical operation process. The strengthening of human-machine interaction will inevitably lead to a lack of interaction between people, making science popularization—a cause full of warmth—cold and mechanical, thereby depriving it of the humanistic care and spiritual consolation it should possess. However, as a cause whose primary goal is “serving people’s all-round development,” science popularization in the new era places greater emphasis on value guidance.

In addition, although AI technology can be used to convey science popularization content to the public in a vivid and intuitive way, this is merely a brief, one-way, and isolated presentation. What the public absorbs is still definite knowledge, and there is a lack of the collision of ideas that occurs in communication between people, making it difficult to improve their ability to transfer knowledge and draw inferences about other cases from one instance. This is not conducive to enhancing the public's scientific thinking or their mastery of scientific methods.

4.2 Countermeasures

The risks arising from the application of AI in science popularization services are ultimately attributable to the alienation of the relationship between humans and technology—that is, the phenomenon of alienation pointed out by Marx and Engels in the “Preface” to *The German Ideology*, namely that “the creator is subordinated to his creation” [32]. In this regard, we need to correctly understand the relationship between humans and technology, enhance the science popularization capacity of science popularization personnel, establish relevant norms, and endow AI technology with the connotations of value rationality.

4.2.1 Enhancing Science Popularization Personnel's Understanding and Use of AI

The essence of dependence on AI is the loss of human subjectivity in the face of AI, and the fundamental reason lies in the rigidity of human capabilities and the rapid development of AI capabilities. Therefore, the key to breaking dependence on AI in science popularization services lies in enhancing the science popularization capacity of science popularization personnel.

On the one hand, training in AI technology should be strengthened to deepen science popularization personnel’s understanding of AI. Science popularization personnel need to keep up with the frontiers of science and technology, understand the development trends of AI, correctly understand the labor-tool attributes of AI, and firmly establish the concept that “humans are the leaders of science popularization services.” Although AI can play an important role in science popularization services, this does not mean that AI can take care of everything, nor does it mean that science popularization personnel play only the role of operating AI; they should consciously and proactively reduce their dependence on AI. On the other hand, science popularization personnel's ability to use AI should be enhanced. On the basis of a correct understanding of AI, the subjective initiative of science popularization personnel should be fully mobilized; by combining the advantages of AI in image and text generation and scene presentation, the forms of science popularization services should be enriched so that, while safeguarding the authority of science popularization

services, their interest and audience acceptability are enhanced, thereby winning the public's trust in science popularization services delivered by science popularization personnel and reducing the public's reliance solely on AI in the course of science popularization services.

4.2.2 Regulating the Application Boundaries of AI in Science Popularization Services

To avoid the blind use and misuse of AI in science popularization services and keep its use under control, we need to strengthen the ethical governance of AI science and technology and clarify the application boundaries of AI in science popularization services. In March 2022, the General Offices of the CPC Central Committee and the State Council issued the Opinions on Strengthening the Governance of Science and Technology Ethics, which explicitly proposed to “continuously promote science and technology for good and for the benefit of mankind” [33], providing basic principles for regulating the application of AI in science popularization services.

First, the bottom line for the application of AI in science popularization services must be strictly observed. The “people-oriented” principle should be upheld, the boundaries between technological and social development should be clearly drawn, natural laws should be respected, and a harmonious relationship between humans and nature and between humans and society, with intelligent technology at its core, should be built. The purpose of “science and technology for good” should be strictly observed, and “the good of science popularization” should be superimposed on “the good of science and technology” to ensure that the intelligent technologies used in science popularization services aim to promote a better life for the people.

Second, explainable AI should be used. In 2019, the National New Generation Artificial Intelligence Governance Expert Committee issued the Governance Principles for a New Generation of Artificial Intelligence: Developing Responsible Artificial Intelligence, which pointed out that AI systems should continuously improve their explainability [34]. In science popularization services, science popularization personnel should also follow the principle of using “explainable intelligent technology” and, with respect to principles such as feature importance and sensitivity analysis in deep learning algorithms, develop visual interpreters to achieve algorithmic transparency, so that intelligent technology can be used with confidence.

Third, a science popularization ethics review mechanism and a punishment mechanism for falsifying science popularization content should be established in accordance with relevant regulations. The relevant legal and policy systems should be further improved, and a mechanism for the ethical review of AI-based science popularization should be established, including aspects such as review procedures, review standards, and measures for handling violations. On this basis, a punishment mechanism for falsifying science popularization content using AI should be established, penalties for creating and disseminating falsified science popularization content should be clearly defined, and the science popularization service behavior of individuals and platforms should be regulated. Penalties for using AI to fabricate science popularization content should be increased, a cross-departmental joint law enforcement mechanism should be established, and international exchanges and cooperation on science popularization regulations should be strengthened to address cross-border science popularization fraud.

4.2.3 Embedding Value Rationality Above Technical Rationality

Science popularization is in itself a practice full of humanistic care, whether it is transmitting knowledge or spreading the scientific spirit, ideas, and methods. If AI regulates science popularization services into an assembly-line operation process that pursues extreme low cost and high efficiency, then the value attributes that science popularization should possess—such as respect for people and the promotion of people's all-round development—will be strongly undermined. In this regard, we need to endow the application of AI in science popularization services with value rationality on top of technical rationality.

Value rationality originated from reflection on and criticism of technical rationality's pursuit of efficiency while ignoring value and fairness; it emphasizes that humans are the ultimate purpose of any practical activity and that technology is merely a means of action. When AI is applied to science popularization services, it should

be emphasized that the tool attributes of AI match the value attributes of science popularization, and the two can achieve synergy through integration and symbiosis, promoting the high-quality development of science popularization services. Moving toward high-quality development, science popularization services need to achieve the technicalization of science popularization services, while high-quality development requires the humanization of technology. Only when the technicalization of science popularization services and the humanization of technology are unified can the high-quality development of science popularization services be achieved.

First, the original aspiration and mission of science popularization must be upheld. No matter how AI technology develops and how important a role it plays in science popularization services, science popularization should always take serving people's all-round development as its basic starting point. By enhancing the public's scientific literacy and strengthening their ability to handle practical problems and participate in public affairs, the significance and value of science popularization are demonstrated. A focus on technical rationality should be avoided, as should turning the public's handling of practical problems and participation in public affairs into fixed procedures.

Second, fabricating technological myths must be prohibited. The application of AI in science popularization services has indeed greatly improved the effectiveness of science popularization services in a short period of time, but it has also given rise to some extreme statements, such as "in the future there will be no need for personnel to carry out science popularization; if people have questions, they can just ask a large AI model directly." Such statements should be strongly resisted and people should be guided back to rationality. They are not only unhelpful for the acceptance of AI by advocates of "value rationality" in science popularization but may instead lead them to more resolutely oppose and resist AI. Some science popularization activities focus too much on technological display and neglect the public's actual need for improving scientific literacy, so that after participating, the public cannot apply what they have learned to real life. Specific measures should be proposed for always centering on the core goal of serving people's all-round development in the design and implementation of science popularization projects, such as optimizing strategies for links like demand research and effectiveness evaluation and feedback.

Finally, the creativity of science popularization personnel's work must be respected. Science popularization services involve the reprocessing and effective dissemination of scientific knowledge and constitute highly creative work with a high threshold. In applying AI to science popularization services, the principle of using technological tools to stimulate and strengthen the creativity of science popularization personnel should be followed, and the instrumental rationality of AI should not be allowed to replace the subjectivity and creativity of science popularization personnel; otherwise, the healthy and sustainable development of the cause of science popularization will be affected.

5 Conclusion

In May 2019, in a congratulatory letter to the Third World Intelligence Congress, President Xi Jinping emphasized the need to "take the new generation of artificial intelligence as a driving force for leapfrog scientific and technological development, industrial upgrading, and the overall rise of productivity, and strive to achieve high-quality development" [35]. Looking ahead, the role of AI as a tool in the field of science popularization services will become increasingly prominent, and the era of intelligent science popularization is approaching. We should examine the advantages and limitations of AI in science popularization services with a more scientific attitude, maximize strengths and avoid weaknesses, firmly seize the tremendous opportunities that AI provides for the transformation of science popularization services, promote the high-quality development of science popularization, and provide strong and powerful support for enhancing citizens' scientific literacy and helping to realize people's modernization.

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