Research on AI-Driven Personalized Science Communication Pathways

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Abstract: *With the progress of scientific communication and the demand for intelligence in the new media era, the old one-way mode can no longer meet all the learning needs of the people. With the development of artificial intelligence, scientific communication can be personalised according to different interests, knowledge systems and cognitive styles of people to make it easier to understand. The concept and cognitive features of personalised scientific communication are introduced in this paper, and it is proposed that artificial intelligence can improve semantic understanding, build knowledge graphs, create multi-modal content, and establish a communication path based on content creation, audience analysis and integrated pathway linking. Optimisation of Multimodal Interaction and Iterative Update Strategies are also being studied. Based on the above research, artificial intelligence has changed the way science is communicated from linear diffusion to data-driven and cognitively coordinated, and new theoretical and methodological support has been provided for personalised and intelligent communication.*

Keywords: *Artificial Intelligence and Personalised Scientific Communication: Semantic Organisation, Audience Profiling , Optimisation of Communication Channels*

Introduction

Scientific communication aims to connect science with the public, spread scientific knowledge among all sections of society, and inspire more people to learn about science. With the development of the information environment and changes in demand from all sides, the old way of spreading scientific knowledge in a one-way manner is no longer suitable; it is too general, lacks differentiation, and cannot meet the various learning needs of different people. With the development of artificial intelligence in recent years, natural language processing, semantics, knowledge graphs, multimodal generation, etc., new motives for scientific communication have emerged, and various cognitive styles and specific dissemination needs can now be met flexibly. Research on personalised scientific communication paths driven by artificial intelligence is a typical case of the change in the theory of scientific communication from macro-level universality to micro-level adaptability, and it is also an indispensable way to achieve deep understanding and cognitive co-construction of scientific knowledge. Based on the analysis of the basic elements, relationship structure and optimisation methods for personalised communication paths mentioned above, this paper hopes to offer some theoretical support and technical ideas for the development of new intelligent, personalised and organised scientific communication models.

1. Theoretical Foundation of AI-driven Personalized Scientific Communication

1.1 Connotation and Cognitive Features of Personalized Scientific Communication

Personalized scientific communication is a way of spreading scientific knowledge that is adjusted according to the different cognitive needs and other factors of individuals. According to what the people know, what they are interested in and how they learn best, adjust the content and form of communication. The first kind of scientific communication is very general and one-way; on the other hand, personalised scientific communication is more specific, well-expressed and interactive. The connotations are that one can choose various materials according to the desired semantic effect and organise the information architecture in different ways to present the knowledge in different ways. Based on the continuous analysis of the needs and thinking processes of all kinds of people, personalised scientific communication can help them learn and understand new knowledge better according to their own circumstances and lives.

Cognitively, personalised scientific communication is aware of the different structures of people's cognition and adjusts accordingly in interaction. Fundamentally, it is an end-oriented modification of cognition that uses all kinds of information filtering and semantic association mapping to achieve hierarchical control from the macro knowledge framework down to the micro information unit. The goal of the Communication Model is to make knowledge more accessible and semantically consistent, so that new information can be continuously connected with what has already been learned in an organised manner. By changing the content and matching it with the current circumstances, personalised scientific communication can help people learn new knowledge more easily, and they will be better able to understand and remember it[1].

1.2 Technology Empowerment Logic of Artificial Intelligence in Scientific Communication

Artificial intelligence can help collect information intelligently, organise semantics, and create all kinds of multimodal content for the purpose of scientific communication. At the bottom of the above technology is the combination of large-scale data learning, natural language processing and knowledge graph construction. Deep learning and semantic analysis are employed to organise all kinds of data from various places, such as scientific papers, pictures, sound, etc., automatically discover knowledge components, and accurately label the connections among them. Therefore, scientific knowledge can be presented in many ways according to different levels of cognition via algorithms, and it does not need to be in a single track. At this time, artificial intelligence can be used to present the knowledge in an accessible way for the public and help them learn difficult or abstract scientific ideas better.

Artificial intelligence technology has been used to improve how we communicate and to continually update the content that is produced. According to the behaviour of the audience and other real-time data, artificial intelligence will be able to change the speed and content of the broadcast for different people. Knowledge graphs and recommendation algorithms can be combined to keep the accuracy of scientific information and, at the same time, add related knowledge and organise it logically to provide personalised learning paths. Many types of scientific knowledge can be presented in various forms by means of multimodal generation technology, such as text, pictures, sound, virtual reality, etc. Therefore, the presentation of scientific knowledge can take a more cognitively and psychologically favourable form and is thus easy to learn and remember.

1.3 Value and Academic Significance of Research on Individualized Scientific Communication Paths

Research on AI-driven personalised scientific communication paths is an application of the theory of scientific communication and one of the main research directions in knowledge dissemination models. It can show how scientific knowledge has developed and been spread by generations of people through algorithms and changes in thinking. Therefore, the data can be used to build a new theoretical system for the study of science communication. No longer do we need to transmit knowledge through experience in the old way; instead, according to the different cognitive levels of people, it can be presented in many forms to provide a new basis for teaching and improve the effectiveness of science communication for everyone[2].

Recently, research on personalised scientific communication paths has been developing over the past few years, and now it is an interdisciplinary field that integrates studies in communication, cognition and artificial intelligence. Systematically analysing the contents of creation, changes in people's thoughts and behaviour, etc., we can build a complete analysis path to collect data, make sense of it, and adjust the path accordingly. The research mentioned above will promote the development of the field of scientific communication and introduce a new type of dissemination model based on multidimensional dynamic networks. More importantly, it provides new ideas for the application of AI in cognitive processing and semantic generation of knowledge; scientific communication can move away from the former mode of simple dissemination of information and enter a deeper state of cognitive collaboration powered by intelligent algorithms, and new academic horizons will be opened for future research on intelligent communication.

2. Constructive Elements and Associative Structures of Personalized Scientific Communication Pathways

2.1 Personalised Expression Logic of Content Generation and Semantic Reorganisation

The foundation of personalised scientific communication is content creation and semantic organisation; thus, in-depth semantic analysis of scientific information and the construction of multi-dimensional units of knowledge need to be carried out. Natural language processing, knowledge extraction and semantic network construction techniques are used to find and label concepts, causal chains and logical relationships in scientific papers at various levels, and thus organise the abstract and linear scientific knowledge into organised, interconnected knowledge networks. Contextual inference and semantic similarity in generative models can be used to create all kinds of versions at different levels of complexity and depth according to the cognitive levels and information needs of different groups, achieving precise adaptation and dissemination of macro-level knowledge frameworks down to micro-level information details.

Semantic organisation is the organisation of information, but it also refers to the optimisation and restructuring of forms of knowledge expression and narrative logic. Artificial intelligence can change the order and speed of presentation of scientific knowledge dynamically according to the current knowledge network, semantic comprehension ability, cognitive traits, etc., to build an organised presentation framework around the main ideas and expand to related knowledge. The expression logic above can improve the semantic cohesion and cognitive fluency of scientific communication, help the audience build an organised system of ideas and knowledge in their studies, etc. With the addition of multimodal generation technology, new forms of presenting knowledge have been introduced; by organising the text logically, using pictures to show ideas more intuitively, and adding sound, it can help students better absorb abstract scientific knowledge through all senses and become more interested in learning it[3].

2.2 Associative Construction of Audience Profiling and Dynamic Adaptation

The other is to know the audience of the scientific communication. The first is to build a detailed model of the public's interests, semantic knowledge and other resources based on all kinds of behaviour and cognition. Artificial intelligence will continue to collect data on how people use AI, what has been learned and what is interesting to them, in order to personalise the learning experience. These models are not fixed attributes but also dynamic cognitive structures that change with the level of knowledge and behaviour, so they can offer stable yet flexible support for the next steps of content matching and optimisation of communication paths.

Change according to the changes in the profile of the audience and modify the generated content accordingly. According to the live data feedback and adjustment of feature weights, artificial intelligence can vary the accuracy and speed of information dissemination for different groups of people based on their different levels of understanding at various times. Adaptation algorithms based on knowledge graphs and reinforcement learning can be employed to modify the distribution plan of content recommendations according to different weather conditions. Associative construction can enhance the link between scientific knowledge and people's cognition, change the form of scientific communication from the spread of information to active thinking induction, promote audience participation, and gradually improve their scientific literacy.

2.3 Systematised Integration of Pathway Association Structures

A pathway association structure can be employed to organise and optimise personalised scientific communication for all people. The aim is to construct a closed-loop, flexible and scalable communication network that can promptly address changes in content production and the diffusion of users. Based on knowledge graphs, semantic networks and interaction data, a structure can be built to show the logical relationships and semantic connections among all levels of nodes, forming ordered and progressive dissemination chains for all kinds of knowledge units. According to changes in the profile of the audience and real-time feedback, the path has been continuously optimised, and now the communication structure has many levels and nodes; thus, personalised delivery and differentiation of content can be achieved for different groups of listeners[4].

Organise a system of communication links so that these links can be organised and developed in an orderly manner. At the same time, AI also needs to organise the information and plan the way forward. Algorithm optimisation can help organise communication among all the links in a way that is favourable to the interests of different people at different times in their studies. The three are connected to form a closed-loop system that can be employed to enhance the specificity and rationality of the spread of scientific knowledge. Organisation of the construction of pathway association structures can help us go from local adaptation to global optimisation in personalised scientific communication, and it will provide a strong foundation for the future development of intelligent communication systems with high adaptability and evolutionary ability.

3. Optimisation of Individualized Scientific Communication Paths Based on Artificial Intelligence

3.1 The Role of Multimodal Interaction in Optimizing the Communication Path

The first goal of using multimodal interaction to optimise personalised routes for presenting science is to collect information from all kinds of places and connect it with various senses so that people can learn better. Deep neural networks, multimodal fusion and feature embedding technology are employed to extract all kinds of features from various types of scientific data, such as pictures, sound and writing, build cross-modal mappings in a single semantic space, etc. Therefore, there will be both uniformity and change in perception at this time. Visual cues can help people learn about space and structure in science; speech input does not need to learn abstract concepts, and text is organised information. Together, these channels can better spread the knowledge and keep it alive over time. Now, multimodal interaction is being used to change the one-way flow of scientific communication and, at the same time, present and convey complex scientific knowledge to the public in new ways.

Optimisation is to add movement and change the direction of expression. Based on multimodal perceptual data, artificial intelligence can observe how people look at things, what they say, how they behave, etc., to learn about people's attention and emotions, understand what interests them, and how well they have grasped the content. Collect all kinds of observation and behaviour analysis data on people's cognitive load in real time, and then dynamically adjust the speed and content of the displayed information to be attractive. Therefore, there will be continuous changes and no longer be fixed. An optimisation model for multimodal interaction can promote the development of scientific communication and attract the attention of the public; at the same time, it can provide a large amount of data for self-adaptive optimisation and continuous improvement of communication channels[5].

3.2 Optimisation Strategies for Knowledge Recommendation and Iterative Update

The first goal of knowledge recommendation is to customise the way of scientific communication for different people; according to the model for analysing their interests, cognitive ability and knowledge demands, relevant information will be provided to help them learn continuously. Collaborative filtering, deep semantic matching and knowledge graph reasoning are used to calculate the semantic relevance and logical dependency weights of scientific knowledge nodes at different levels, and then progressive recommendation sequences that branch out from core concepts to related knowledge are generated. Therefore, all the links in the knowledge can be shown more clearly, and the audience will not be overwhelmed by too much general knowledge. It will help people learn the difficult contents of science in an organised manner.

Iterative update is employed to modify the communication path according to feedback and learn independently. According to the actual use data and feedback from the public, the artificial intelligence system will dynamically adjust its parameters and update the weights of the recommendation model to change the recommended content in response to changes in people's knowledge and interests. Therefore, it will be ensured that the released information is timely and suitable, and the self-organised development of knowledge chains will also be promoted. Therefore, through this communication path, we will gain more profound knowledge of the science and logic. Knowledge recommendation and iterative updates are a kind of closed-loop system that includes information filtering, pathway optimisation and cognitive guidance; therefore, they can provide technological support for continuous improvement in the scientific literacy and long-term cognitive development of the audience.

3.3 Future Directions for Optimising the Personalised Communication Path

In the future, with the release of more open AI algorithms, semantic generation and cognitive modelling will be added to further customise the spread path of scientific knowledge. Explainable AI will change the way opaque, black-box recommendations are built and optimised by creating traceable chains of reasoning, so it will be possible to verify the verifiability and academic reliability of content generation and recommendation logic. With the development of semantic generation technology, the range and expression strength of scientific knowledge will also increase; generative models will be able to change the content dynamically according to changes in the narrative structure based on real-time feedback from the audience. Thus, people can be themselves and still be reasonable. Research on the application of cognitive psychology and brain-computer interface technology can offer new theoretical and technical support for pathway optimisation, help systems obtain and predict people's cognitive states and emotions more directly, and move from passive adaptation to active guidance[6].

Another reason for the improvement in the future will be to integrate everything. Combine the ideas of cognitive science, linguistics and human-computer interaction with AI algorithms to learn more about how the human mind works and apply this knowledge. Association mining can be used to connect large-scale knowledge graphs and cross-domain data, expanding the path of communication beyond what is possible in single-discipline knowledge; gradually, cross-disciplinary knowledge networks will be built to meet all kinds of cognitive demands for people in complex scientific fields. In the future, the individual paths of scientific communication will develop into intelligent communication systems that can learn autonomously, self-correct and adapt according to intelligent evolution, semantic adaptation and cognitive synergy. It will provide a good theoretical and technical foundation for the spread and exploration of scientific knowledge.

Conclusion

Research on AI-driven personalised paths for science communication has found that the model of science communication is changing from linear to networked and adaptive. By integrating the technologies of semantic organisation, multimodal interaction, audience profiling and dynamic adaptation, it is possible to optimise all links in the chain of science communication according to the cognitive characteristics of the people, and increase their interest in learning and participation. In the future, with the development of explainable artificial intelligence and semantic generation technology, we will be able to achieve transparent optimisation and intelligent evolution of communication paths. Another direction of research is interdisciplinary collaboration; that is, by combining the results of research in cognitive science, linguistics and human-computer interaction, large-scale knowledge graphs can be used to build cross-disciplinary knowledge networks and meet all the cognitive demands of complex scientific problems. With the continuous development of intelligent evolution, semantics and cognition have changed; therefore, we will build more solid theoretical and technological support for the efficient dissemination of scientific knowledge and all-round improvement in scientific literacy through personalised science communication paths.

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