The Development of Artificial Intelligence in Career Initiation Education and Implications for China

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ABSTRACT

Artificial intelligence (AI) is currently exerting a significant impact on the development of career guidance education, facilitating personalized guidance and data-driven decision-making for students. The historical and evolutionary trajectory of AI-driven career guidance education can be traced back to its early stages as assistive functionalities, which have now advanced to encompass robust learning applications, such as multimedia and interactive features, machine learning, and natural language processing. Notably, AI has transcended its conventional role in vocational development and expanded into the realms of social and emotional learning. The complexity of AI research in international contexts necessitates consideration of various factors, including cognitive development, parental involvement and supervision, and cultural backgrounds. Despite certain limitations in utilizing AI for career exploration, it has brought numerous impacts and insights. These primarily manifest in the areas of data-driven decision-making and the outlook for career exploration, the demand for cultural sensitivity in AI-driven career guidance, and the provision of personalized career guidance through artificial intelligence in education.

Keywords: Artificial Intelligence; Career Initiation Education; Career Exploration; Personalized Guidance.

In today's rapidly evolving world, career guidance education has become increasingly vital for students across the globe. Integrating Artificial Intelligence (AI) into career guidance education has led to significant advancements and innovations, offering personalized career guidance to students and driving lifelong career education. Internationally, AI-supported career guidance education has become a transformative approach to career counseling, providing students access to vast information, tools, and resources related to different professions. Through AI technology, students can explore multiple career paths, comprehend job requirements and skills, and receive personalized guidance based on their strengths, interests, and career aspirations. The application of AI in career guidance education holds tremendous potential and encompasses various dimensions, including utilizing AI algorithms for automating tasks for teachers and parents, monitoring children's progress and achievements, and delivering tailored learning experiences. This paper will systematically review AI's historical development and application areas in career exploration for children and adolescents in international countries, examining the benefits and challenges that arise during its implementation and drawing insights from international experiences that can be valuable for China. This paper will also investigate the ethical factors that need to be considered when applying AI in career guidance education, such as data privacy, algorithm biases, and accountability.

I. HISTORY AND DEVELOPMENT

Since the inception of AI-assisted tools in the 1960s, international countries have witnessed significant development in career guidance education. Today, AI-driven career exploration tools exhibit robust interactivity and personalization, integrating multimedia, simulations, and assessments to offer immersive experiences. Machine learning, natural language processing, and computer analysis are employed as potential instruments to match individual skills and interests, expanding choices beyond traditional paths. Moreover, they are increasingly integrated into socio-emotional learning to support personal and Career development. Over time, these approaches have gradually become a consideration in people's career planning. AI technology is profoundly and extensively impacting various industries and has found applications in numerous emerging fields.

A. Early AI-assisted Functions

AI-assisted career exploration tools originated in the 1960s, marking a significant transformation from traditional pen-and-paper testing methods in career exploration. During this period, AI algorithms were employed to develop computerized versions of Self-Directed Search and Strong Career Interest Blank, both aimed at aligning adolescents' interests and skills with suitable career choices [1], [2]. Although these early AI tools opened up new pathways for
individuals to explore potential career paths, their scope and accuracy were severely limited. For instance, they lacked modern AI tools’ interactive and immersive functionalities and failed to consider changes in work environments and emerging career choices.

Despite these limitations, early AI-assisted career exploration tools hold a seminal significance for contemporary, more complex, and interactive career exploration tools [3]. These modern tools integrate multimedia, simulations, and components of socio-emotional learning, providing individuals of all age groups with more engaging and personalized career exploration experiences. With the continuous advancement of AI technology, its application in career guidance education has gradually evolved, offering children and adolescents more opportunities to explore career choices while considering their specific interests, skills, and personality traits.

B. Multimedia and Interactive Artificial Intelligence

Multimedia, interactive AI, and other career exploration tools reshape the connection between individuals and potential career success. Traditional methods like career information brochures or job fairs often lack interactivity and personalization, failing to help individuals understand their needed opportunities. In today's rapidly evolving socio-technological environment, the demand for future talents is constantly increasing, and people are exploring ways to acquire relevant knowledge and experiences from the internet. For instance, videos, games, simulations, and assessments provide immersive experiences. Videos offer visual presentations of specific professions, games, and simulations that allow individuals to try different experiences while assessments match interests, skills, and values with potential careers.

In the 21st century, many developed countries have witnessed a surge in the development of AI-driven career exploration tools characterized by advanced multimedia and interactive features. For example, “MyNetMove” uses AI algorithms to match personal interests, skills, and potential professions [4]. “Naviance” integrates various technologies such as interactive assessments, lists of professional interests, and college search tools [5]. “Roadtrip Nation” showcases successful professionals who have found fulfillment in their careers by following their passions [6]. “Planet Beruf” provides job-seeking strategies and support to students with disabilities or other special needs [7]. As these tools become increasingly sophisticated, their sense of engagement and personalized experiences significantly impact people's job prospects, salary expectations, and educational and training requirements. These innovative AIs are helping individuals explore potential careers in a whole new way, making the career exploration process more convenient, efficient, and enjoyable.

C. Integration of Machine Learning and Natural Language Processing

Integrating machine learning and natural language processing into AI career exploration tools has wholly transformed children and adolescents' exploration and engagement patterns in potential career development. As a subset of artificial intelligence, machine learning allows algorithms to learn from data and make predictions and decisions without explicit programming [8]. On the other hand, natural language processing enables computers to understand and analyze human language. In recent years, the development of AI career exploration tools that combine machine learning with natural language processing has experienced explosive growth. Such tools can analyze massive amounts of data and provide personalized career advice based on individual interests, skills, and experiences. For example, "IBM Watson Career Coach" utilizes natural language processing to analyze job seekers' resumes and data from "LinkedIn", providing personalized career recommendations based on their skills and experiences [9].

The "CareerExplorer" platform utilizes machine learning to match personal interests and characteristics with potential career exploration [10]. The fusion of machine learning and natural language processing into AI career exploration tools makes career exploration more personalized and expands the range of career options for individuals. Traditional careers are no longer the sole choice, as children and youth can now explore alternative career paths that may better suit their skills and interests.

D. Expanding beyond Traditional Career Development

In recent years, AI-assisted career exploration tools have experienced significant growth, and the range of careers available for exploration has been expanding. In the past, these methods primarily focused on traditional professions such as medicine, law, engineering, accounting, and other established fields. However, changes in social and economic trends have led to the rise of the gig economy, making soft skills increasingly important. Many industries are automating and standardizing, reducing workers' requirements in manufacturing, services, and other sectors. Simultaneously, new industries and career fields are continuously emerging due to technological advancements and the emergence of the gig economy. Therefore, AI-driven job search platforms like "Indeed" [11] and "Glassdoor" [12] have become popular tools for exploring careers in fields such as e-commerce, digital marketing, and social media management.

While exploring new career targets, these platforms are also used to assist individuals in exploring non-traditional career paths such as entrepreneurship and freelancing. In the context of the gig economy and the rise of online platforms for selling goods and services, traditional careers are no longer the sole focus, and people are more inclined towards non-traditional careers to pursue their passions and dreams, thereby gaining greater flexibility and autonomy. Platforms like "Upwork" [13] and "Fiverr" [14] are examples of how they facilitate freelancing opportunities in graphic design, writing, and software development for children and adolescents. Additionally, "GrowthMentor" [15], an AI-driven mentoring and coaching platform, provides guidance and support to individuals seeking to start their businesses or ventures.

E. Social Integration and Emotional Learning

Integrating Social and Emotional Learning (SEL) into AI career exploration tools has become a significant development direction in recent years. International scholars have recognized the demand for social and emotional abilities in the workplace and have incorporated AI career exploration tools into SEL to help young people cultivate these skills.
while exploring their potential career goals. Initially, AI-assisted career exploration mainly focused on providing information about different professions and fields. However, online assessments have been developed to measure children and adolescent's social and emotional abilities, helping them understand their self-awareness and interpersonal communication skills. Subsequently, the assessment results are used to provide feedback on potential career development that aligns with their social and emotional capabilities. AI career exploration tools have evolved to utilize natural language processing to analyze written responses, determine the levels of social and emotional abilities, and offer personalized feedback and career advice.

Furthermore, Virtual Reality (VR) technology has become a practical approach to developing immersive experiences for social and emotional abilities. VR utilizes Augmented Reality (AR) or Virtual Reality (VR) technology to simulate virtual characters in real-time, providing users with a more realistic virtual world experience. This has become an essential trend for children and adolescents to simulate work environments. Besides technology, career exploration programs now include workshops and training courses that foster social and emotional abilities such as communication, teamwork, and leadership. These programs offer children and adolescents opportunities to engage in community service, role-playing, and other activities that enhance social and emotional development.

II. THE COMPLEXITY OF ARTIFICIAL INTELLIGENCE IN CAREER HEAD START EDUCATION

AI-based career exploration tools play a crucial role in assisting children and adolescents in Europe and America to explore and discover interests, passions, and cognitive aspects. These tools offer opportunities for a broader range of career choices and provide valuable insights into the job market and the educational and training pathways required for different professions. Designing AI-based tools for children usually involves considerations at three levels: the micro-level, meso-level, and macro-level. The micro-level refers to the cognitive development of children and adolescents regarding AI; the meso-level entails parents becoming participants and supervisors in the children's use of AI tools; and the macro-level involves cultural backgrounds perpetually influencing technological developments. Compared to adolescents, more simplified, intuitive, and interactive means are essential for children to explore their interests effectively. Overall, AI as a tool for children and adolescent career guidance should possess characteristics such as attractiveness, interactivity, and age-appropriateness to support the career development process effectively.

A. Cognitive Developmental

Cognitive development theories propose that a child's thinking progresses through stages, each building upon the previous one [16]. Within these stages, various abilities, such as attention, memory, and processing speed, have different demands. Piaget suggested that children's cognitive development is influenced by their experiences and actively constructs their understanding of the world through interactions [17]. Over time, experiences, observations, and exposure to career-related information and resources influence children's conceptual thinking and cognition. During childhood, they are in the preoperational stage, characterized by the cultivation of symbolic thinking and the use of language to articulate objects and thoughts. This stage lays the foundation for developing more complex cognitive skills, such as problem-solving and critical thinking abilities.

As increasing numbers of AI tools are being utilized in the education sector, it is crucial to consider how these technologies impact children's cognitive development. Empirical evidence indicates that learners achieve better learning outcomes when actively participating in the learning process [18], [19]. Other researchers have proposed interactive and engaging elements in AI tools, such as games and simulations, which can motivate children to play an active role in learning [20]. For instance, in educational games, some schools in the United States use “Scribble Pressy” [21] as part of their counseling programs. This software allows children to create stories and illustrations, fostering creativity, imagination, and problem-solving abilities. It is worth noting that there is still a lack of empirical evidence regarding the cognitive effects of career exploration tools or games. AI-based career exploration tools may have limitations in empathy and intuitive qualities during the interactive process, potentially limiting the depth of the exploration experience. Furthermore, the neurobiological mechanisms of how AI influences cognitive behavior are not fully understood, with only a few neuroimaging studies exploring this issue [22].

B. Parental Involvement and Supervision

The role of parents in their children's education has always been a subject of debate. According to Rousseau, parents are the most natural and excellent educators for children, and they should allow children to grow at their own pace and according to their individual abilities and interests [23]. From this perspective, parents play a crucial role in guiding children's growth and providing necessary support and resources. Similarly, based on Dewey's theory, education should be a collaborative effort between teachers and parents, and parents positively influence shaping children's learning experiences [24]. Parents have a unique understanding of their children's needs and interests, which allows them to provide valuable insights into children's learning preferences and styles [25].

In reality, AI systems are typically developed and deployed on the internet platform, where many unsafe factors exist, such as online pornography, cyberbullying, and online scams. Regarding online safety, parents are often the first testers of these applications, and their first impression determines whether they will allow their children to use them. As Kant stated in his moral philosophy, humans have a natural inclination towards autonomy and freedom, and any attempt to restrict them must be based on moral principles [26]. Parents play a crucial role in supervising and ensuring that technology use carries no risks and fulfills their moral responsibilities. To address this, various countries have enacted a series of privacy protection laws for children. For instance, in the United States, the Children's Online Privacy Protection Act (COPPA) requires websites and online services to obtain parental consent before collecting personal
information from children under 13 years old [27]. Similarly, the General Data Protection Regulation (GDPR) of the European Union calls for parental consent when processing personal data of children and adolescents under 16 years old [28]. These measures aim to protect the rights and interests of children and adolescents to the greatest extent possible under the law.

C. Background Culture

The cultural background in which children grow up influences their values, beliefs, and worldview. This characteristic stems from the diversity of cultures in different countries and regions, which impacts children's early learning and development. Education should be based on learners' life experiences, acknowledging their cultural background as an essential factor in teaching and providing appropriate guidance and assistance [29]. Children's cultural background influences their career aspirations and goals. For example, traditional Ayurvedic and other healing practices in India are highly valued, making the medical field a popular career choice among the population [30]. In Japan, business is at the core of the economy, leading to a strong emphasis on careers in business, engineering, and law [31]. In the Middle East, Islam prohibits involvement in producing and selling alcohol and pork products [32]. Therefore, when designing AI-based tools, children's cultural background must be a crucial consideration, and career exploration options that align with their cultural experiences and values should be provided. This ensures that the tool is relevant, meaningful to the target audience, and aligns with the cultural values and expectations of the community.

On the other hand, language needs to be taken into account. Different cultures have subtle language differences, and language use can significantly impact children's understanding and engagement with content. For instance, children from different cultural backgrounds may not understand idioms or colloquialisms specific to certain cultures, leading to confusion or misunderstandings. Therefore, many software developers make considerable efforts to develop multilingual versions to promote their products. For example, SPSS 29.0, a commonly used statistical analysis software in social sciences, has been developed in 13 different languages, such as English, French, Chinese, etc., as of 2022 [33].

III. LIMITATIONS OF CAREER EXPLORATION IN ARTIFICIAL INTELLIGENCE

Firstly, adolescents or adults may have a clearer understanding of career aspirations and life goals [34]. In contrast, children are still in the stage of understanding and integrating into the world, influenced by various factors. Thus, it is challenging to predict the most suitable career path to meet their needs and desires. Although AI is often considered a possible solution due to its ability to analyze vast amounts of data and provide personalized recommendations based on individual interests and strengths, it has limitations. Human decision-making is complex and multifaceted, and AI may struggle to capture subtle differences in children's cognition, emotions, and environmental changes [35][36]. As children are in a developmental stage, their decisions can be unpredictable, and their interests may undergo rapid changes.

Furthermore, AI primarily relies on data analysis and algorithms for decision-making. Despite AI's capabilities in data analysis surpassing many devices, the available data can still be limited, biased, or false. Humans are not merely a sum of data points but complex and multifaceted individuals with unique personalities, experiences, and desires [37]. Some research indicates that at its current level, AI may struggle to provide truly personalized and realistic advice that reflects individual children's unique needs and desires [38].

Secondly, research shows that the quality of data used to train AI significantly affects the accuracy of its recommendations [39]. This implies that the accuracy and reliability of AI-generated suggestions may directly depend on the quality and quantity of data input into the system. Data availability and quality constrain AI's ability to provide personalized recommendations based on data analysis, and algorithms may unavoidably opt for more flexible signal pathways for efficiency. As mentioned earlier, aspects of human growth, such as social and emotional development, cannot be fully grasped through data analysis. Human interactions involve a range of subtle and complex cues, including body language, tone of voice, and eye contact, which AI may not easily capture. Substituting technology for human interaction could diminish humans' rich and complex experiences. Social and emotional skills developed through interactions with others are essential for children's growth as they must learn to navigate complex relationships and communication. Humans possess unique empathic abilities, creativity, and intuition, so they set children and adolescents apart from machines.

Thirdly, AI may not necessarily consider the potential influences of cultural, social, economic, and other factors on children and adolescents career exploration. Children from low-income families may have different access to resources and opportunities than their wealthier counterparts. Many studies demonstrate that socioeconomic background is crucial in career choices and outcomes [40]. Another study found that the combination of adolescent aspirations and educational level is the primary driver of youth career development, with these factors mediating to some extent the influence of socioeconomic background [41]. Children from low-income families may face systemic barriers when accessing essential opportunities for career development, such as quality education, guidance, and networking. AI systems may also rely on historical data reflecting traditional gender roles, leading to recommending more stereotypical "male" careers to boys and more "female" careers to girls. This could limit children and adolescents' career choices and perpetuate gender stereotypes in the long term. Considering these complex social, cultural, and other factors, AI-powered career advice is unlikely to be a "one-size-fits-all" solution.

Finally, the limitations of AI in providing guidance and support to young children in early career exploration also raise ethical considerations regarding the use of technology in human development. Children are curious, vulnerable, inexperienced, and mindlessly trusting of AI. AI systems are generally owned and controlled by private companies, and applying them to career exploration raises concerns about data privacy and ownership. Ensuring that those responsible

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for developing and implementing AI systems for children adhere to high ethical standards is paramount. As AI increasingly permeates various aspects of our lives, it is essential to consider the consequences of relying on technology to perform traditional human tasks.

IV. IMPLICATIONS AND INSIGHTS

From international theoretical research and practical experience, a series of universal positive implications can be summarized regarding AI’s intervention in career enlightenment education for children and adolescents. In fact, AI has had a profound impact on the entire educational environment, completely transforming the way we live and learn. Successful experiences in career exploration from abroad may inspire career enlightenment education in China. The Chinese government and non-governmental organizations, the academic community, schools, and the public have engaged in a series of positive explorations in this area. Although various factors influence the depth and breadth of these initiatives, the era of big data presents both challenges and new opportunities for promoting the development of career enlightenment education in China. The international experiences and limitations have brought potential impetus for technological innovation, cultural sensitivity, and educational reform in the Chinese education landscape.

A. The Future of Data-Driven Decision-Making and Career Exploration

Big data, machine learning, and natural language processing have always driven the development of AI. These technologies make AI more sophisticated and capable of handling massive amounts of data and making data-driven decisions. The role of technology in career exploration is an important and complex issue. A profound understanding of the impact of technological innovation on society, work, and life is crucial. AI-driven career enlightenment tools for children and adolescents have tremendous potential to shape the future of education and work. As the demand for tech talents grows, European and American countries have invested heavily in the education industry, making children a key focus of cultivation. For instance, the US government is actively striving to become one of the global leaders in AI technology and has invested substantial funds for that purpose. The successful experiences of American companies and organizations in using AI for career enlightenment may inspire software development in China. While China has also made significant progress in artificial intelligence, it is more evident in the medical industry, such as the AI Clinical Decision Support System (AI+CDSS) project [42]. As early as 2017, China issued the "New Generation Artificial Intelligence Development Plan," aiming to make China a world leader in AI theory, technology, and applications by 2030 [43]. Undoubtedly, the technological gap between China and Western countries is gradually narrowing. The "AI+Education" project initiated by the Ministry of Education in 2018 provided pioneering experiences for China [44]. Considering China's nearly 300 million children, there is an urgent need for technological support and data analysis capabilities to develop age-appropriate games, chatbots, monitoring devices, and VR experiences for their career exploration. Therefore, technological innovation is of paramount importance. In summary, promoting career enlightenment education in China from a technological perspective requires four aspects: (1) National-level AI strategy. China has already formulated a blueprint for AI development, but specific strategies for each industry may need to be revised or completed. The government must continuously improve and refine AI development plans and strategies for different industries, such as finance, healthcare, transportation, and education. (2) Investment in research and development: Encourage state-owned or private enterprises to invest in AI research and development, especially funding for academic and research institutions to promote innovation and advance the field. (3) Education and talent development: Major universities must cultivate professionals with expertise in artificial intelligence and innovative thinking abilities to meet social and national strategic demands. (4) Ethics and responsibility: It is essential to ensure that the development and deployment of AI comply with ethical standards and are in line with legal regulations, including addressing issues of discrimination, privacy, and accountability.

B. Cultural Sensitivity in Artificial Intelligence and Career Guidance

As a unique dimension of early childhood career enlightenment education, cultural sensitivity cannot overlook the cultural differences between international countries and China. Abroad, unique insights into AI for children and career guidance emphasize the importance of considering cultural factors in career exploration. Taking the United States as an example, it emphasizes individualism and personal autonomy, which may influence the formulation and implementation of career guidance plans for children and adolescents. They focus on assisting children in discovering their strengths and interests, encouraging them to seek careers that align with their attributes. On the other hand, in China, people tend to emphasize collectivism and social responsibility. The goals may focus on helping children and adolescents think about the more excellent benefits to the family and society.

Similarly, regional, linguistic, cultural, and social factors can all influence children's exposure to AI devices and applications and their responses to them. Therefore, a copy-and-paste approach is not appropriate when referring to international cases. It is necessary to make corresponding adjustments and optimizations based on China's unique cultural background to ensure that AI technology can better serve China's education and social development. However, it is essential to emphasize that this perspective may reinforce existing biases and cultural stereotypes.

In summary, promoting career enlightenment education in China from a cultural perspective requires three aspects: (1) Cultural values and beliefs. With an emphasis on understanding and respecting Chinese cultural values and beliefs, educational content, tools, and methods should align with the cultural norms and expectations of socialism with Chinese characteristics. (2) Language and dialect recognition. AI systems should be able to recognize regional dialects and accents to ensure that the technology can be used and be effective for users of all ages. (3) Experience design. The user
experience should consider the unique needs and expectations of Chinese children. Some children's career dreams in China may be unusual or unrealistic, such as wanting to become superheroes, fairies, or billionaires. These dreams exist in the children's imaginative world and should not be seen as abnormal career aspirations. AI can facilitate user interaction with technology and ensure that the design of AI systems is intuitive and user-friendly.

C. Personalization of Career Guidance: The Role of Artificial Intelligence in Education

Personalized career guidance should prioritize the needs of participants and promote lifelong career learning. Under the influence of AI, children and adolescents' career exploration highlights the potential for AI to transform traditional approaches in the educational environment. AI can conduct personalized career guidance based on individual strengths, interests, and career aspirations, providing students with targeted and efficient coaching. Expanding to the educational level, AI may bring personalized learning experiences to students and automate administrative tasks for teachers, thereby enhancing overall teaching effectiveness. Different from Western countries, the application of AI in the education field in China faces several challenges. Some people believe that AI may weaken the guidance role of teachers and reduce the significance of interpersonal interactions in learning. Additionally, there are concerns about the quality of educational materials mediated by AI and the potential for algorithmic biases during their creation. To address the shortcomings of AI education in China, three possible solutions are proposed at the educational level: (1) Integration of Tradition and AI: While AI can bring significant benefits to education, traditional teaching methods should be partially abandoned. The two should strike a balance to ensure students receive a comprehensive education. (2) Personalized Education: AI should develop personalized learning plans based on students' individual needs and abilities to help them learn at their own pace and in the most suitable way. (3) Teacher Involvement: Frontline teachers should actively participate in developing and implementing AI-driven educational tools. This will help ensure that AI's application aligns with positive and scientifically sound teaching approaches.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

REFERENCES


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