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Introduction to Research Methods in Education

**The Mixed Methods Research Questions on the Cultivation of Students'
Digital Literacy in Rural Schools in Heilongjiang Province in the Era of
Artificial Intelligence**

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1. Introduction

This research is about to explore the situation of cultivating students' digital literacy in rural schools in Heilongjiang Province in the era of Artificial Intelligence(AI). The exploration draws from relevant literature to identify the research area, with a focus on the literacy education in rural schools in Heilongjiang.

With the rapid development of artificial intelligence technology, many traditional professions are gradually being replaced by machines, but at the same time, many professions related to digital technology have emerged. In such an era, cultivating students' digital literacy has become increasingly important. Cultivating students' digital literacy can not only help them adapt to the future job market, but also improve their employment competitiveness. It can also stimulate their innovative thinking and cultivate their ability to use digital technology to solve problems. Digital literacy is not only a technical skill, but also an interdisciplinary knowledge integration ability (Martínez-Bravo, M., Sádaba-Chalezquer, C. and Serrano-Puche, J. 2020). By cultivating students' digital literacy, it can promote their knowledge transfer and integration between different disciplinary fields, and improve their overall quality. Digital literacy includes the cultivation of information literacy and critical thinking. In the era of information explosion, cultivating students' digital literacy can help them distinguish the authenticity of information, evaluate its value, and improve their critical thinking ability. With the widespread application of artificial intelligence technology, issues related to privacy, security, fairness, etc. are gradually becoming prominent. While cultivating students' digital literacy, it also cultivates their moral concepts and ethical considerations, guiding them to use digital technology correctly. Therefore, cultivating students' digital literacy is an important measure to meet the development needs of

the artificial intelligence era. This is of great significance in promoting social progress and economic development.

Heilongjiang Province, located in the northeastern part of China, compared with the central and coastal provinces, is relatively less developed. There is often a significant digital divide, with limited access to resources and opportunities for digital literacy development in Heilongjiang Province, especially in rural areas. This can result in educational disparities and hinder students' ability to thrive in an increasingly digitally driven world. Therefore, exploring the cultivation path of students' digital literacy in Heilongjiang rural areas is crucial for addressing the digital divide and promoting equitable educational opportunities.

2. Literature Review

The term 'digital literacy' was first used in a book published in 1997 by Paul Gilster. Gilster (1997, quoted in Reedy and Parker, 2017, p. 5) defined it as the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers. The concept of literacy goes beyond simply being able to read; it has always meant the ability to read with meaning, and to understand. It is the fundamental act of cognition. According to Sousa and Rocha (2019), there is a stake of digital skills for disruptive digital business, and they connect it to the latest developments, such as the Internet of Things (IoT), cloud technology, big data, artificial intelligence, and robotics. The topic is even more important given the large disparities in digital literacy across regions (Tinmaz, Fanea-Ivanovici, and Baber, 2023).

We live today in a society permeated by the digital and digital literacy has become a vital skill for students to adapt to the rapidly evolving technological landscape, especially in the age of AI. According to Dufva, T. and Dufva, M. (2019), society is increasingly digitalised and connected, with computers and algorithms mediating much of people's daily activity in one way or another. Blue (2022) argued that the development of digital literacy skills is crucial in helping students

become lifelong learners. Meanwhile, Mokhtari (2023) also emphasizes the importance of digital literacy, pointing out that in today's increasingly digital world, students and teachers must master digital skills to achieve success.

But in rural areas, schools face challenges in cultivating students' digital literacy. According to Manny, L. et al. (2021), limited infrastructure and resources may be significant obstacles for these rural schools to effectively implement digital literacy programs. Many rural areas lack stable internet connectivity and sufficient educational technology equipment due to their remote geographical location and limited economic conditions. This makes it difficult for teachers to effectively utilize digital tools for teaching, and students also have difficulty accessing rich digital learning resources.

Falloon, G. (2020) emphasized the need for teachers in rural areas to enhance their digital literacy skills in order to effectively train their students, and pointed out that the lack of trained teachers may hinder the development of students' digital literacy. Rural teachers often lack continuous training and development opportunities, and are unable to timely understand and master new educational technologies, resulting in limited levels of their digital literacy. This makes it difficult for teachers to effectively integrate digital technology into their teaching and provide effective digital learning guidance to students.

In addition, the imbalance of educational resources between urban and rural areas has also led to differences in the quality and depth of content for students when receiving digital education. In some rural areas, due to cultural and conceptual limitations, parents and educators may have doubts about digital education, which to some extent limits the efforts of schools to cultivate students' digital literacy (Reynolds, R. 2016).

According to Sun, M., & Zhao, L. (2023), promoting the digital transformation of rural education governance is an inevitable requirement for deepening the reform of education system, and it is also a key step for China's overall realization of education modernization.

Given the current situation of cultivating digital literacy among rural students, it has become crucial to address the challenges of digital literacy education for rural school students. Based on these considerations, the author has determined the research direction and questions to understand the current situation and plan the future path of digital literacy education in rural schools in Heilongjiang Province.

3. Theoretical Framework

In the process of studying this issue, I will use the philosophy of Epistemology as a beacon to guide my academic exploration. According to Norris, C. (2005), epistemology - inquiry into the nature, possibility and scope of human knowledge - has been at the heart of the philosophy from ancient Greek times to the present.

The reason why this question is applicable to the research philosophy of Epistemology is mainly because it focuses on the essence, sources, and acquisition methods of knowledge, especially the integration of digital literacy education into rural school curricula.

Firstly, epistemology emphasizes a deep understanding and exploration of knowledge. Maynard (1994, quoted in Moon *et al*, 2021) discusses that epistemology is the branch of philosophy that asks: how do we know what we know? It is concerned with how we can ensure that knowledge is both adequate and legitimate. In the integration of digital literacy education in rural schools, we need to understand what digital literacy is, why it is so important for rural students, and how to effectively integrate this educational goal into the existing education system. This involves a clear definition of the concept of digital literacy, an understanding of its applicability in rural education environments, and how to effectively implement it.

Secondly, this issue focuses on the main factors that affect digital literacy education in rural schools. This involves exploring various internal and external factors that may affect digital literacy education, such as educational policies, teacher resources, student needs, parental attitudes, and community support. Epistemology emphasizes the process of knowledge

generation and validation. According to Al-Ababneh, M., (2020), the first element, epistemology is described as inherent in the theoretical perspective as “a way of looking at the world and making sense of it”. Therefore, this study will not only consider existing policies and resources, but also explore the implementation effects of these policies and resources, as well as how they change over time and environment.

Finally, the issue also focuses on the formal level of digital literacy education in school curricula. This involves an overall understanding of the school curriculum, as well as an understanding of the status and value of digital literacy education in the school curriculum. Epistemology not only focuses on the content of knowledge, but also on the organization and presentation of knowledge, as well as how it relates to other knowledge (Araújo, P., Tennis, and Guimarães, J. 2017). This study will consider how digital literacy education is integrated with other school curricula, as well as its position and role in school education goals.

The foundational question of epistemology is how we know what we know. Epistemology is a branch of philosophy that goes to the roots of our knowledge by asking not just the methods of acquiring knowledge but also to examine the conditions and the context of knowledge generation (Khondker, H., 2022). Epistemology focuses on knowledge and how knowledge is acquired and validated, which is related to information collection, data analysis, and the researcher's cognitive approach to the research object. This question involves in-depth exploration of the essence, sources, and validation of knowledge, a comprehensive examination of various factors that affect the integration of digital literacy education, and a comprehensive understanding of the formal level of digital literacy education in school curricula. Therefore, this question is very suitable for using Epistemology as its research philosophy.

4. Research Questions

In order to delve deeper into this field, the following 3 research questions that can be answerable through a mixed methods approach to data collection are proposed.

Question 1: What are the predominant factors influencing the integration of digital literacy education in the curriculum of rural schools in Heilongjiang, and to what extent is digital literacy education a formal part of the school curriculum?

Question 2: How does the implementation of a digital literacy intervention program impact the digital skills and confidence levels of students in selected rural schools in Heilongjiang?

Question 3: How do the social and economic conditions in rural communities in Heilongjiang influence the digital literacy cultivation of students, and to what extent do these conditions shape the students' access to digital resources and opportunities?

These questions will help to comprehensively understand the current status of digital literacy education in rural schools in Heilongjiang and to outline a blueprint for future development. Through the use of mixed methods, it will be possible to collect and integrate both quantitative and qualitative data, thus enabling a more comprehensive and in-depth analysis of influencing factors. This will provide more specific guidance for digital literacy education.

4.1 A Brief Analysis on Research Questions

The first research question belongs to a descriptive research design because its primary objective is to describe and analyze the current state of digital literacy education in the curriculum of rural schools in Heilongjiang, including the factors influencing its integration and the formality of its inclusion. It provides a platform for quantifying variables, understanding relationships, and achieving a holistic understanding of the factors influencing the integration of digital literacy education in rural school curricula.

The second research question is suited to experimental research design as it involves the deliberate implementation of a digital literacy intervention program, the comparison of outcomes between intervention and control groups, and the aim to establish a causal relationship between the intervention and the changes in students' digital skills and confidence

levels. This research design also structured to allow for replication of the study to confirm the validity of the results, which fits within the experimental research design. Bhattacharjee, A. (2019) points that experimental research is best suited for explanatory research-rather than for descriptive or exploratory research-where the goal of the study is to examine cause-effect relationships. It also works well for research that involves a relatively limited and well-defined set of independent variables that can either be manipulated or controlled.

The third research question fits within the explanatory research design framework because it seeks to explain the underlying mechanisms and causal relationships between social and economic conditions and their influence on digital literacy cultivation and access to digital resources among students in rural communities in Heilongjiang.

Having briefly analyzed the research questions and identified their respective design requirements, we can now explore the application of mixed methods for Research Questions.

4.2 The Application and Justification of Mixed Methods for Research Questions

In this section, the path how to apply mixed methods to the proposed research questions and the reasons why they are appropriate will be provided.

4.2.1 The Application and Justification of Mixed Methods for Research Question 1

Research question 1, with its combination of quantitative and qualitative phases, is well-suited to explore the predominant factors influencing the integration of digital literacy education in the curriculum of rural schools in Heilongjiang and to assess the formal status of digital literacy education within the school curriculum. The justifications are just as follows.

Quantitative Phase: Survey or questionnaire can be used. By conducting a survey or questionnaire, specific quantitative data regarding the presence of digital literacy education in the curriculum, its frequency, and the level of support it receives can be gathered. This

quantitative data can provide insights into the formal status of digital literacy education within the curriculum. The survey or questionnaire can measure the extent to which digital literacy education is integrated into the curriculum, allowing for the collection of quantitative data that quantifies the presence and frequency of digital literacy education components.

Qualitative Phase: Interviews and focus group discussions will be applied. Qualitative data gathered through interviews and focus group discussions will allow researchers to explore the complex and nuanced factors influencing the integration of digital literacy education. This can include gathering insights on barriers, facilitators, and the decision-making processes related to digital literacy education from the perspectives of teachers, school administrators, and education policymakers. Interviews and focus group discussions can provide in-depth qualitative insights that go beyond the surface-level quantitative data, capturing the perspectives, opinions, and experiences of key stakeholders involved in the implementation of digital literacy education in rural schools.

The proposed research design combines the strengths of both quantitative and qualitative research methods to address the multifaceted aspects of the research question. Integrating both quantitative and qualitative data will provide a thorough understanding of the predominant factors influencing the integration of digital literacy education in the curriculum of rural schools in Heilongjiang, as well as the formal status of digital literacy education within the school curriculum. This approach allows for a holistic analysis that goes beyond mere numerical data, enhancing the depth and breadth of the research findings.

4.2.2 The Application and Justification of Mixed Methods for Research Question 2

The proposed research design 2, which includes both quantitative and qualitative phases, is well-suited to address the question of how the implementation of a digital literacy intervention program impacts the digital skills and confidence levels of students in selected rural schools in Heilongjiang. Here's the justification for why this design is appropriate:

Quantitative Phase: Pre- and post-intervention assessments will be applied. By conducting pre- and post-intervention assessments using standardized tests, surveys, or other quantitative measures, researchers can quantitatively measure the changes in students' digital skills and confidence levels. This allows for the collection of specific quantitative data to assess the impact of the intervention program. Utilizing standardized tests and surveys provides objective and measurable data for assessing changes in digital skills and confidence levels. This quantitative data enables researchers to quantitatively evaluate the impact of the intervention program.

Qualitative Phase: Interviews and focus group discussions will be used. Qualitative data gathered through interviews, focus group discussions, or open-ended survey questions can provide insights into the experiences of students and teachers with the digital literacy intervention program. This allows for exploring their perceptions of the program's impact on their digital skills and confidence in a qualitative manner. Qualitative data captures the experiential insights, perceptions, and subjective experiences of the participants, offering a deeper understanding of the impact of the intervention program beyond mere numerical data.

The proposed research design is appropriate because it combines the strengths of both quantitative and qualitative research methods to address the multifaceted aspects of the research question, providing a thorough understanding of how the implementation of a digital literacy intervention program impacts the digital skills and confidence levels of students in selected rural schools in Heilongjiang. This approach allows for a holistic analysis that considers both the quantitative changes in digital skills and confidence levels as well as the qualitative experiences and perceptions of the participants.

4.2.3 The Application and Justification of Mixed Methods for Research Question 3

The proposed research question 3, comprising quantitative surveys and questionnaires for data collection on social and economic conditions, standardized tests for digital literacy levels, as

well as qualitative interviews and focus groups for exploring experiences and perspectives, is highly appropriate for examining the influence of social and economic conditions on digital literacy cultivation and access to resources in rural communities in Heilongjiang. The justifications for its appropriateness are as follows:

Quantitative Phase: Surveys and questionnaires will be used. These tools are effective for gathering quantitative data on the social and economic conditions within different rural communities. They can capture demographic information, economic indicators, and community resources related to digital literacy cultivation and access to digital resources. Standardized tests or assessment tools will also be used. Researchers can objectively measure the digital literacy levels of students in various rural communities. This allows for the collection of quantifiable data, enabling the comparison of digital literacy levels across different communities.

Qualitative Phase: Interviews and focus groups will be employed. Qualitative data gathered from interviews and focus groups provides contextual insights into the experiences and perspectives of students, parents, and teachers regarding digital literacy cultivation and access to digital resources. This qualitative approach is key for capturing the nuanced aspects of the influence of social and economic conditions. Qualitative data can offer rich descriptions of how social and economic conditions impact students' access to digital resources and opportunities, including the barriers and facilitators related to digital literacy cultivation. This approach complements the quantitative findings by providing a deeper understanding of the underlying factors.

The integration of quantitative and qualitative data allows for a comprehensive analysis that considers both the statistical relationships between social and economic conditions and digital literacy levels, and the contextual and experiential dimensions of these relationships. Therefore, the proposed research design is highly appropriate for addressing the research question 3: How social and economic conditions in different rural communities in Heilongjiang influence the

digital literacy cultivation of students and shape their access to digital resources and opportunities. The integration of quantitative and qualitative methods ensures a thorough and nuanced examination of the multifaceted relationships involved in this complex research question.

5. Conclusion

A mixed methods approach combining qualitative and quantitative research paradigms would be well-suited for investigating the digital literacy cultivation of students in Heilongjiang rural areas. The justifications of these research paradigms are based on the relevance of qualitative and quantitative methods in addressing the specific research questions and the need to capture both subjective and measurable aspects of digital literacy cultivation in the rural education context.

By using a mixed methods approach, this research will provide a comprehensive understanding of the current situation of students' digital literacy cultivation in Heilongjiang rural areas. The research can also gain a comprehensive understanding of both the subjective experiences and measurable aspects of digital literacy, leading to more critical findings. The findings of this research will contribute to the development of more effective digital literacy education programs in rural schools, leading to improved outcomes for students in these regions.

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