THE RELATIONSHIP BETWEEN TEACHERS' DIGITAL LITERACY ABILITY AND TEACHING INNOVATION EFFECTIVENESS AT GUANGXI SECOND LIGHT INDUSTRY TECHNICIAN COLLEGE*

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Abstract

The research objectives are: 1) to study the digital literacy ability of the teachers at Guangxi Second Light Technical College, 2) to study the teaching innovation effects of Guangxi Second Light Technical College, 3) to study the relationship between the digital literacy capabilities and teaching innovation effects of the teachers at Guangxi Second Light Technical College. To obtain the research results more accurately, the sample group used in this study includes 144 teachers in Guangxi Second Light Industry Technician College. The research instrument is questionnaires. The statistics are used for data analyzing by finding frequency, percentage, mean, standard deviation, and Pearson product moment correlation.

The research results were:

1. Teachers' digital literacy ability at Guangxi Second Light Technical College in 5 aspects were at a high level ($\bar{X}$=3.56, S.D.=1.21). The highest-ranked is "Awareness of digital ethics and security" ($\bar{X}$=3.63, S.D.=1.22, indicating a high

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level. The second is “Ability in digital instructional design” ($\bar{X}$=3.59, S.D.=1.21), while “Mastery of data literacy and analytical skills “ranks the lowest ($\bar{X}$=3.49, S.D.=1.18).

2. Teaching innovation effectiveness of Guangxi Second Light Technical College in 6 aspects was at a high level ($\bar{X}$=3.55, S.D.=1.24). The highest rank was “Innovation of management process” ($\bar{X}$=3.63, S.D.=1.18), indicates a high level. Followed by “Innovation of teaching mode” ($\bar{X}$=3.57, S.D.=1.26), whereas “Integration of educational resources” was the lowest rank ($\bar{X}$=3.49, S.D.=1.26).

3. The overall relationship between teachers’ Digital literacy ability and teaching innovation effectiveness has a positive correlation at the high level with statistical significance level at .01 (r=0.86).

Keywords: Teachers’ Digital Literacy, Teaching Innovation Effectiveness, Guangxi Second Light Industry Technician College.

Introduction

Digital transformation has driven the modernization of vocational education. The digital literacy of teachers is the key to integrating digital technology with vocational education. However, the development of digital literacy among teachers in vocational colleges in China is uneven, and their ability to apply it deeply is insufficient. For instance, Hazier and Kurl (2024) conducted a systematic review in their paper titled "How Teachers Utilize Digital Learning Platform Data to Support Instructional Design", which explored the theme of "how teachers utilize digital learning platform data to support instructional design". This study, in a digital and intelligent learning environment, indicates that teachers' instructional design capabilities are not only reflected in the application of digital tools but also in their understanding, analysis, and application of learning data. That is to say, in a digital teaching environment, teachers often focus more on the development of technology integration and instructional

design skills. (Daming, H. et to all. 2023, Peihao, X. et to all., 2023) However, Arthur and Kurl (2024) conducted a systematic review and pointed out that in a digital learning environment, teachers not only carry out teaching activities through digital platforms but also continuously optimize instructional design based on the data generated by the platforms. They noted that teachers can "dynamically adjust teaching content and activities by using learning behavior data and learning outcome data from the learning platform", thereby enhancing the pertinence and effectiveness of instructional design. (Xiang Hui, J. et to all., 2023, Yanting, C. et to all., 2023, Intarasompun, W., et to all. 2022)

Current research has confirmed the positive correlation between digital literacy and teaching innovation, but it mainly focuses on regular universities and primary and secondary schools, lacking empirical research on technical colleges and in-depth analysis of the correlations among various dimensions. (Meng, C. et to all., 2023; Zimin, Z., et to all., 2023; Zhonghua. et to all., 2023). The Guangxi Second Light Industry Technician College has the characteristics of teachers being proficient in basic digital skills but lacking in data analysis capabilities and having a relatively weak ability to integrate educational resources in teaching innovation. This study takes this college as the research object, aiming to fill this research gap and has the following four research significances: clarifying the current levels of these two variables in the college, enriching empirical research on the digitalization of vocational education, and providing practical references for similar colleges.

Objectives

1. To study the digital literacy capabilities of the teachers at Guangxi Second Light Technical College.

2. To study the teaching innovation effects of Guangxi Second Light Technical College.

3. To study the relationship between the digital literacy capabilities and teaching innovation effects of the teachers at Guangxi Second Light Technical College.

Literature Review

The literature review explores two keys relevant to the research areas.

1. Teachers' digital literacy ability

Teachers' digital literacy has evolved from an early emphasis on "technical operation skills" as a tool-oriented understanding to a comprehensive professional ability that encompasses technology integration, instructional design, data analysis, collaborative communication, and digital ethical awareness. UNESCO (2018, 2024) pointed out in the "Teacher ICT Competency Framework" that teachers' digital literacy not only includes the ability to apply information and communication technology but also should reflect the ability to integrate teaching and make data-driven decisions. The TPACK framework proposed by Mishra and Koehler (2006) further emphasizes that truly effective digital literacy lies in the dynamic integration of technological knowledge, pedagogical knowledge, and content knowledge. Meanwhile, studies by Truong and Diep (2021) and Hase and Kuhl (2024) indicate that in actual educational settings, teachers tend to prioritize the development of digital tool application and instructional design abilities, while data literacy and in-depth analysis capabilities lag behind, presenting a structural imbalance. Additionally, Floridi (2013) and Van der Sloot (2020) from the perspectives of information ethics and data privacy suggest that digital ethics and security awareness have become important components of teachers' digital literacy. Overall, teachers' digital literacy is a multi-dimensional, integrated, and dynamically developing professional ability structure, and its development level directly affects whether technology can truly be transformed into an effective force for teaching improvement.

2. Teaching innovation effect

The effect of teaching innovation is regarded as a comprehensive outcome of multiple levels and structures within the education system, covering dimensions such as the innovation of teaching models, the optimization of the curriculum system, the improvement of students' learning outcomes, the professional development of teachers, and the improvement of management processes. Hargreaves (2020) and Fullan (2013) point out that teaching innovation is not merely the update of methods or tools, but rather a transformation process of teachers' professional concepts and cooperative culture; Darling-Hammond et al. (2022) emphasize that innovation must be based on learning evidence and respond to student differences to promote educational equity. At the level of learning outcomes, Bloom's (1968) mastery learning theory and Hattie's (2009) meta-analysis research both prove that formative assessment and high-quality feedback are important mechanisms for enhancing learning outcomes.

3. Research Framework

In this study, the relationship between the digital literacy of teachers at Guangxi Second Light Industry Technician College and the effect of teaching innovation is explored. The independent variable is the digital literacy of teachers, which includes proficient use of digital tools and applications; mastery of data literacy and analysis skills; digital teaching design capabilities; online collaboration and communication skills; and digital theory and security awareness. These dimensions are based on Truong and Diep (2023), who focused on teacher capabilities and organizational driving factors. They emphasized that teachers' proficiency is the key to effectively integrating digital tools. Their proposed comprehensive proficiency model defines proficiency as the combination of technical knowledge (TK), pedagogical content knowledge (TPACK), and adaptive teaching strategies. The dependent variable is the effect of learning innovation, which includes innovative teaching models; optimization of the curriculum system; improvement of students' learning outcomes;

professional development of teachers; integration of educational resources; and innovation in management processes. These innovations are centered on the Innovation Management System (IMS) in Natalia Karstegl's research, which systematically examines the mechanism of management process innovation in organizational innovation through a systematic review and quantitative analysis of relevant literature from 2003 to 2023. She pointed out that management process innovation is not merely isolated improvements in technology or tools, but an overall system arrangement that includes strategic alignment, organizational structure, process design, cross-departmental collaboration, knowledge management, and cultural support. Her core argument is that only by embedding innovation activities into standardized and sustainable management processes can organizations continuously enhance their innovation capabilities and performance.

The research framework can be illustrated by the following chart:

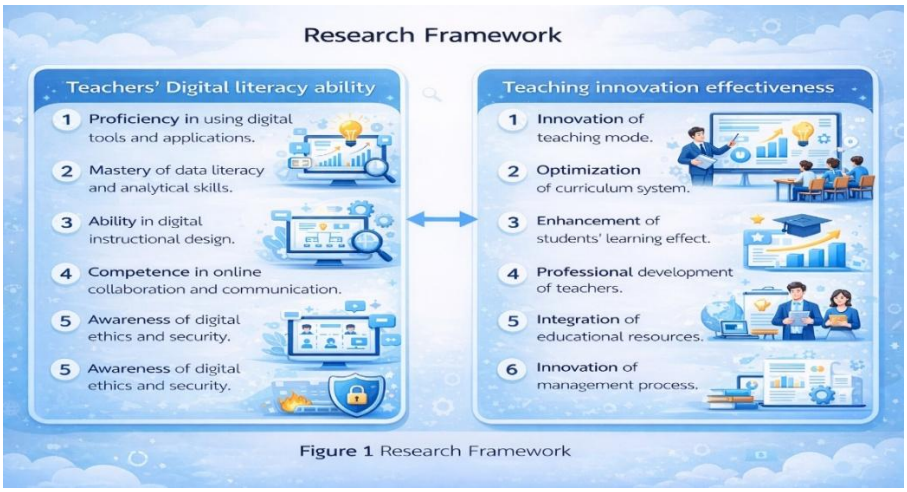

Figure 1 Research Framework

Methodology

1. Population and Sample Group

The population of this study consists of 230 teachers at Guangxi Second Light Industry Technician College. Based on Krejcie and Morgan's (1970) table, a random sampling method was used to select a sample group of 144 in-service teachers from the college.

2. Research Tools

The research tool is a questionnaire consisting of three parts:

Part 1: General Information, which includes six items to collect background information such as the respondents' age, work experience, educational background, professional title, administrative position, and teaching courses.

Part 2: Teachers' Digital Literacy. This part uses a 5-point Likert scale with standardized labels ranging from "Strongly Disagree (1)" to "Strongly Agree (5)" to measure attitudes and perceptions. It contains statements related to digital literacy and is divided into five dimensions: 1) Proficient use of digital tools and applications; 2) Mastery of data literacy and analysis skills; 3) Digital teaching design ability; 4) Online collaboration and communication skills; 5) Digital ethics and security awareness.

Part 3: Teaching Innovation Effectiveness. This part includes five rating scales and measures statements related to teaching innovation using a 5-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree". It is divided into six dimensions: 1) Teaching model innovation; 2) Curriculum system optimization; 3) Enhancement of student learning outcomes; 4) Professional development of teachers; 5) Integration of educational resources; 6) Innovation in management processes.

All statements are consistent with the measurement objectives, as evidenced by the average score of the Index of Item-Objective Congruence (IOC)

ranging from 0.67 to 1.00. The reliability of the pilot test of the questionnaire was evaluated using Cronbach's **α** alpha coefficient (a measure of internal consistency), with **α** value of 0.891, indicating excellent internal consistency.

4.Data Collection

To collect the necessary data for this study, the researchers took the following steps:

Distribution: Online questionnaires were distributed to teachers at Guangxi Second Light Industry Technician College through digital channels. Each respondent was informed of the purpose of research, confidentiality, and the principle of voluntary participation.

Platform Utilization: Data was collected through the "Questionnaire Star" online platform, which facilitated efficient data collection and management.

Data Screening: After the collection period, the raw data was screened. Invalid responses, such as incomplete forms or patterned answers, were excluded to ensure the integrity of the results.

Analysis Preparation: The final valid data set was coded and organized for statistical processing and analysis.

4. Data Analysis

Part 1: To study the digital literacy of teachers at Guangxi Second Light Industry Technician College, the data was analyzed using means and standard deviations.

Part 2: To study the teaching innovation effectiveness, the data was analyzed using means and standard deviations.

Part 3 The relationship between the digital literacy of teachers and the teaching innovation effectiveness was analyzed by using the Pearson Product Moment Correlation Coefficient (r).

Results

Part 1: Teachers' Digital Literacy Competence

Table 1: The average values ($\bar{x}$) and standard deviations (S.D.) of teachers' digital literacy competence in five aspects at Guangxi No. 2 Light Industry School

Teachers' Digital literacy ability	$\bar{x}$	S.D.	Level	Ranking
1. Proficiency in using digital tools and applications.	3.54	1.23	High	4
2. Mastery of data literacy and analytical skills.	3.49	1.18	Moderate	5
3. Ability in digital instructional design.	3.59	1.21	High	2
4. Competence in online collaboration and communication.	3.56	1.23	High	3
5. Awareness of digital ethics and security.	3.63	1.22	High	1
Total	**3.56**	**1.21**	**High**	

From Table 1 considering, the overall average of teachers' digital literacy capabilities of the teachers at Guangxi Second Light Technical College in 5 aspects was at a high level ($\bar{x}$=3.56, S.D.=1.21)

The research results of these five aspects are as follows: The highest-ranked is "Awareness of digital ethics and security" ($\bar{x}$=3.63, S.D.=1.22, indicating a high level. The second is "Ability in digital instructional design" ($\bar{x}$=3.59, S.D.=1.21), while "Mastery of data literacy and analytical skills "ranks the lowest ($\bar{x}$=3.49, S.D.=1.18).

Part 2: Teaching Innovation Outcomes

Table 2: The mean ($\bar{x}$) and standard deviation (S.D.) of teaching innovation effectiveness of Guangxi Second Light Technical College in 6 aspects.

Teaching innovation effectiveness	$\bar{x}$	S.D.	Level	Ranking
1. Innovation of teaching mode.	3.57	1.26	High	2
2. Optimization of curriculum system.	3.51	1.28	High	5
3. Enhancement of students' learning effect.	3.55	1.20	High	4
4. Professional development of teachers.	3.56	1.24	High	3
5. Integration of educational resources.	3.49	1.26	Moderate	6
6. Innovation of management process.	3.63	1.18	High	1
Total	**3.55**	**1.24**	**High**	

From Table 2 considering, the overall average teaching innovation effectiveness of Guangxi Second Light Technical College in 6 aspects was at a high level ($\bar{x}$=3.55, S.D.=1.24)

Considering the results of these research aspects were as follows: the highest rank was “Innovation of management process” ($\bar{x}$=3.63, S.D.=1.18), indicates a high level. Followed by “Innovation of teaching mode” ($\bar{x}$=3.57, S.D.=1.26), whereas “Integration of educational resources” was the lowest rank ($\bar{x}$=3.49, S.D.=1.26).

Part 3: To study the relationship between the digital literacy capabilities and teaching innovation effects of the teachers at Guangxi Second Light Technical College .

The overall relationship between teachers' Digital literacy ability and teaching innovation effectiveness has a positive correlation at the high level with statistical significance level at .01 (r=0.86).

Discussion

The relationship between Teachers' Digital literacy ability and teaching innovation effectiveness of Guangxi Second Light Industry Technician College discussed as follows:

1. The research results show that the digital literacy of teachers at Guangxi Second Light Industry Technician College is at a relatively high level. Looking at the measurement results of the five dimensions comprehensively, the highest ranking is "proficient use of digital tools and applications", followed by "digital teaching design ability. This result is mainly closely related to the working environment of vocational college teachers. On the one hand, in recent years, the reform of information-based teaching has been continuously advanced. The frequent use of online teaching platforms, smart classroom systems, and digital resources in teaching has enabled teachers to continuously accumulate experience in tool operation and teaching application. On the other hand, compared with tool usage and teaching design, data literacy and analysis skills are more dependent on statistical thinking, data interpretation ability, and systematic training. The results of this study are consistent with those of Truong and Diep (2021), who emphasized that teachers' professional level is the key to effectively integrating digital tools. They defined professional level as a combination of technological knowledge (TK), pedagogical content knowledge (TPACK), and adaptive teaching strategies. This also indicates that teachers' digital

literacy presents a pattern where "proficiency in tools is higher than data analysis skills". Moreover, these results are in line with the findings of Hase and Kuhl (2024), who conducted a systematic review on the topic of "How teachers utilize digital learning platform data to support teaching design" in their paper "How Teachers Utilize Digital Learning Platform Data to Support Teaching Design". The study pointed out that in digital and intelligent learning environments, teachers' teaching design capabilities are not only reflected in the application of digital tools but also in the understanding, analysis, and application of learning data.

2. The results indicate that the teaching innovation effectiveness of teachers at Guangxi Second Light Technical College is at a high level Considering the comparative results of these six aspects, the highest-ranked dimension was “teaching mode innovation”. This was followed by “teacher professional development”. This pattern may be explained by the fact that instructional innovation and professional development are closely linked to teachers’ daily teaching activities and personal professional growth, making them more visible and easier to implement at the individual level. By comparison, management process innovation often depends on institutional governance structures, leadership support, and cross-departmental coordination, which limits the extent to which individual teachers can directly influence such processes. The findings of this study are in line with the recent research of Hargreaves (2020), which has devoted considerable research effort to exploring the innovation of teaching methods in the context of educational change and teacher professional development. They are also consistent with the research conclusions of Darling-Hammond et al. (2022), a renowned researcher in the field of teacher education and policy, who is dedicated to exploring the innovation of teaching methods, with a focus on equity and evidence-based practices. The research shows that when innovative methods are designed to meet the diverse needs of students -

including those from marginalized backgrounds - and are based on research on how people learn, their effects are most significant.

3. The research findings reveal that the relationship between the digital literacy of teachers and the effectiveness of their teaching innovation at the Guangxi Second Light Industry Technician College showed a significant positive correlation at the 0.01 significance level. This indicates that the higher the digital literacy of teachers, the more significant the effect of their teaching innovation. This result suggests that digital literacy has become an important internal factor driving teaching innovation among teachers, and it significantly promotes the renewal of teaching models, the optimization of courses, and the improvement of teaching effectiveness. From a specific perspective, teachers' advantages in proficiently using digital tools and applications as well as their digital teaching design capabilities provide direct support for teaching innovation. Matthew J. Koehler (2020), who has collaborated extensively with Mishra on the TPACK framework, further explores the practical aspects of digital teaching design ability. Koehler's research focuses on how teachers can develop and apply this ability in real classroom settings. He emphasizes the importance of ongoing professional development that is context - specific and practice - oriented. On the one hand, teachers can flexibly carry out flipped classrooms, project-based learning, and blended teaching by leveraging digital platforms, intelligent teaching tools, and multimedia resources, thereby effectively promoting the innovation of teaching models

Recommendation

The implementation of the research results is as follows:

1. At the school level, systematic training should be strengthened to enhance teachers' data literacy and their ability to apply educational data. Currently, teachers' use of teaching platforms and digital tools is mostly limited

to the operational level, not yet fully mastered the skills of analyzing and interpreting learning behavior data.

2. The concept of data-driven teaching improvement should be incorporated into the teaching management and evaluation system. Schools should create realistic scenarios for data application through institutional design.

3. From the perspective of teaching innovation, enhancing teachers' data literacy helps to promote the transformation of teaching innovation from formal innovation to substantive innovation.

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