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Development of an Information and Communication Technology Literacy Evaluation Model for Vocational College Students in Guangxi

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Abstract

Background and Aims: As the global digitalization process accelerates, the rapid development and widespread application of new ICT technologies, such as AI, cloud computing, big data, blockchain, and the metaverse, have made digitalization the main driver of global social and economic development. Evaluating the ICT literacy of vocational college students is crucial for enhancing their ICT skills and serves as an important foundation for their future career development. This study aims to: 1) investigate the current issues and solutions in the assessment of ICT literacy among vocational college students in Guangxi, and 2) develop an ICT literacy evaluation model.

Methodology: The research methods include semi-structured interviews and the Delphi technique. This study successfully constructed an ICT literacy evaluation model for vocational college students in Guangxi and provided corresponding recommendations, aiming to offer theoretical references and practical guidance for improving students' ICT literacy.

Results: Social responsibility and vocational competency are two components of the ICT literacy model that Guangxi vocational students use to improve their digital literacy and problem-solving abilities. It supports the creation of successful curricula, enhances instructional strategies, and harmonizes evaluation procedures. Curriculum development and educational policies are informed by this model, which also gets students ready for the workforce.

Conclusion: For Guangxi vocational students, the ICT literacy model improves digital skills, problem-solving abilities, and vocational competence, helping to prepare them for the workforce. It also supports the creation of successful curricula and informs policy in education.

Keywords: Elements; ICT Literacy; Evaluation Model

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Introduction

The advent of the information age and the development and application of information technology not only promote people's continuous use and reliance on information technology but also demand necessary information literacy from them. Technologies such as artificial intelligence, big data, and blockchain are rapidly evolving and are expected to profoundly change talent demand and educational forms (Ministry of Education of China, 2018). However, the assessment of ICT literacy among higher vocational students has struggled to keep pace with the rapid development of technological innovations, leading to students' skills and knowledge becoming outdated. The rate at which higher vocational students acquire technical skills in school significantly lags behind the pace of development in information and communication technologies. The ability of higher vocational students to master information technology does not align with societal demands. In this era of information explosion, the ability to identify, process, and discern information has become one of the essential capabilities for living in the present and shaping the future. This necessitates that every student possesses fundamental literacy skills that match those required by an information-based society.

Objectives

1 . To study the elements of Information and Communication Technology Literacy Evaluation Model for Vocational College Students in Guangxi.

2. To evaluate elements and create Information and Communication Technology Literacy Evaluation Model for Vocational College Students in Guangxi.

Literature Review

The Ministry of Education of China continually emphasizes that universities must serve regional economies. Higher vocational colleges should establish scientific, reasonable, and rigorous evaluation indicators for information literacy, which can positively influence the self-development of social information talents. Liu (2023) designed a survey evaluation model for "CTIR university student digital literacy," comprising four primary dimensions: digital awareness, computational thinking, digital learning and innovation, digital social responsibility, and 23 secondary dimensions. A survey of higher vocational students in Hunan Province, China, revealed that students perform well in accessing, understanding, judging, and sharing digital information. However, there is still room for improvement in maintaining digital information security and analyzing and solving problems. However, this assessment model did not cover the application of next-generation information technologies, limiting its comprehensiveness and practicality in a

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rapidly evolving technological environment. Wu (2019) pointed out that the content framework for assessing ICT literacy in the PISA 2021 ICT test mainly focuses on five primary competency domains: accessing, evaluating, and managing information and data; sharing information and communication; transforming and creating information; problem-solving and computational thinking in the digital environment; and appropriate ICT use. However, further discussion is needed on the applicability and effectiveness of these competency domains in different educational contexts, as well as a detailed analysis of students' actual application of these skills. Zhu (2021) integrated the iceberg model and the learning practice process of higher vocational students to construct an evaluation system for information literacy abilities, which includes three primary indicators: information basic literacy, information skill literacy, and information added-value literacy, as well as seven secondary indicators: information sensitivity, information cognition, information collection, information organization and management, information analysis and operation, information ethics, and information responsibility. The study concluded that there are differences in information literacy abilities among higher vocational students in different grades and majors. However, the coverage of indicators is not sufficient, and it fails to better highlight the characteristics of higher vocational students and the changes in information literacy in the new era. Huang (2019) designed an information literacy framework consisting of four primary indicators and 19 secondary indicators, namely information awareness and knowledge, information skills, smart learning and information innovation, and information social responsibility, based on the development and characteristics of students in higher vocational colleges. However, there is insufficient focus on core literacy centered on humans and the development of comprehensive capabilities, and there is a lack of emphasis on thinking and behavioral habits necessary for competent digital survival.

Existing evaluation indicators have not accurately reflected the characteristics of higher vocational students or the new requirements of the information age on their abilities and qualities. Based on previous research, this study adopted methods such as literature review and Delphi expert interviews to determine the five main elements and 27 sub-elements of the ICT literacy evaluation model for higher vocational students in Guangxi. The research results not only help optimize the ICT literacy training model for higher vocational colleges in Guangxi but also enhance students' adaptability and innovation capabilities in the information age. This has significant theoretical and practical implications for cultivating students with high-quality technical skills in information technology.

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Mothodology

Part 1: To study current problems and resolution on information and communication technology literacy evaluation for vocational colleges students in Guangxi.

The Population

Interviewing a total of 21 experts, including 10 computer teachers working in higher vocational colleges in Guangxi, 5 leaders of network centers in higher vocational colleges, and 6 department leaders from higher vocational colleges whose personal specialties and research directions are all ICT-related. All 21 experts have a master's degree or higher, hold the title of Associate Professor or above, and 14 experts have more than 15 years of relevant work experience. The interviewed experts are highly educated, highly titled, and experienced university workers. This provides a solid foundation for conducting surveys through interviews to identify the current status of ICT literacy assessment among students in Guangxi's higher vocational colleges.

Interview form

The instrument to collect the data for objective one, to study the current problems and resolution on ICT literacy evaluation for vocational colleges students in Guangxi was an open-ended Interview. The Interview form was designed based on the current status of ICT literacy evaluation, existing problems in ICT literacy evaluation, and solutions to the problems in ICT literacy evaluation.

Constructing a Semi-structured interview process

The construction process of the Semi-structured interview is as follows:

1) Reviewing and analyzing documents, concepts, theories, and research related to ICT literacy evaluation for vocational colleges students in Guangxi.

2) Develop an interview guide: Although semi-structured, prepare some open-ended questions to guide the conversation.

3) The interviewees were interviewed by face-to-face, telephone, video call and other means.

Data Collection

The data collection for objective 1: to study the current situation of the current problems and resolution on ICT literacy evaluation for vocational colleges students in Guangxi, as following procedure: (1) Record the interview in detail by recording and taking notes. Check and confirm interview content. And (2) The interview records were collated into text materials.

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Data Analysis

Conduct a thorough analysis of the interview content to extract pivotal information and identify key themes. Subsequently, compose research reports based on the insights gleaned from this analysis.

Part 2: to develop the development of an information and communication technology literacy evaluation model for vocational colleges students.

The Population

The study population consists of the same group of 21 experts who have previously participated in the research process and provided valuable opinions and feedback.

Delphi Questionnaire

This study used the Delphi method as its research tool. We developed the following two versions of the questionnaire based on the requirements of the Delphi method:

First Version: A Likert scale questionnaire designed and constructed based on the literature review and in-depth interviews with 21 experts regarding the current situation of vocational education in Guangxi.

Second Version: A revised Likert scale questionnaire that has been modified and optimized according to feedback from the experts.

In order to ensure the tool's scientific validity and reliability, these two versions of the questionnaire gradually optimize and refine it.

Research Process

1) Questionnaire Development: Combine the literature review and the current situation of vocational education in Guangxi obtained from in-depth interviews with 21 experts to design and construct a Likert scale questionnaire for evaluating ICT literacy in Guangxi vocational education.

2) Consistency Review: Distribute the initially designed Likert scale questionnaire to 5 experts for trial use and modify and optimize it based on their feedback. The questionnaire will then undergo an Index of Consistency (IOC) review by the same 5 experts to ensure an IOC range between 0.67 and 1.00, guaranteeing the questionnaire's reliability and validity.

3) Expert Feedback: Distribute the first version of the Likert scale questionnaire to 21 selected experts to solicit their opinions and feedback.

4) Feedback Analysis: Conduct a comprehensive analysis of the expert feedback to extract key information and identify major elements, while appropriately handling elements with differing opinions.

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5) Questionnaire Revision: Based on the expert feedback and the main elements and data obtained in the previous steps, develop a revised second version of the Likert scale questionnaire.

6) Pilot Testing: Distribute the second version of the Likert scale questionnaire to 30 test participants for trial use and further modify the questionnaire based on their feedback.

7) Consistency Re-review: Have 5 experts conduct another Index of Consistency (IOC) review of the revised questionnaire to ensure an IOC range between 0.67 and 1.00, confirming the questionnaire's scientific validity and reliability.

8) Final Expert Review: Distribute the final revised second version of the Likert scale questionnaire to 21 selected experts to solicit their final opinions and feedback.

9) Evaluation Model Construction: Synthesize all feedback to develop a consistent indicator system for the ICT literacy evaluation model, ensuring the model's completeness and practicality.

Results

Identifying Primary Indicators Through Literature Review and Aggregating the Most Common Literacies

Based on the comparison analysis of 12 representative international and Chinese student ICT literacy assessment indicator systems, as shown in Table 1, it can be observed that the primary components of ICT literacy mainly focus on awareness, operation, acquisition, evaluation, and problem-solving. However, there is relatively less emphasis on aspects such as attitude, cybersecurity, presentation, and collaboration. Nonetheless, these literacy components are crucial for the social development of higher vocational students in the information age. From Table 1, it is evident that the main components of ICT literacy are primarily concentrated on awareness, operation, acquisition, evaluation, and problem-solving. Areas with less emphasis include attitude, cybersecurity, presentation, and collaboration. Nevertheless, these literacy components are vital for the social development of higher vocational students in the information age.

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Table 1 Comparison of Indicators Across Different ICT Frameworks

Elements	UNESCO	ICILS(2023)	PISA(2022)	ISTE(2016)	ACRL(2015)	NAEP(2018)	DigComp2.2(2022)	NAP(2020)	China Action	NDC-VC(2020)	ITCS-HVE(2021)	ILCSHE-	Total
Awareness	P				P		P		P	P	P	P	7
Attitude	P						P		P	P	P	P	6
Ethics and law	P	P	P	P	P	P	P	P	P	P	P	P	12
Cyber security	P						P		P	P			4
Knowledge	P					P	P		P	P	P	P	7
Operation	P	P	P	P	P	P	P	P	P	P	P	P	12
Access	P	P	P	P	P	P	P	P	P	P		P	11
Management and organization	P	P	P			P	P	P		P	P	P	9
Integration	P	P	P	P		P	P	P		P		P	9
Evaluation	P	P	P	P	P	P	P	P	P	P		P	11
Application	P	P	P	P		P	P	P	P	P	P	P	11
Presentation	P			P					P	P		P	5
Communication	P			P	P	P	P	P	P	P		P	9
Collaboration	P			P		P				P			4
Problem-solving	P	P	P	P	P	P		P	P	P	P		10
Creation	P	P	P	P	P	P	P	P	P	P			10

Evaluate elements and create an Information and Communication Technology Literacy Evaluation Model for Vocational College Students in Guangxi.

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The results according to objective 2 are shown below. The researchers further divided the observed behaviors into five categories: consciousness and attitude, social responsibility, knowledge and skills, thinking and conduct, and professional thinking and vocational competence. Among these, "Consciousness and Attitude" contains two observed points: Awareness and Attitude, which have a total frequency of 13 and occupy a prominent place. Following that, "Social Responsibility" includes Ethics and Law and Cybersecurity, for a total of 16 frequencies. Subsequently, "Knowledge and Skills" encompasses Knowledge, Operation, and Access, totaling 30 frequencies. "Thinking and Behavior" involves Management and Organization, Integration, and Evaluation, with a total of 29 frequencies. Lastly, "Professional Thinking and Vocational Competence" consists of Application, Presentation, Communication, Collaboration, Problem-solving, and Creation, totaling 7 observed points, which are crucial for vocational development of higher vocational students in the information age, with a total frequency of 50. Observable behaviors related to the five primary dimensions and each dimension's observed points are summarized in Table 2.

Table 2 ICT information literacy evaluation indicators and observable behaviors

Primary Indicator	Secondary Indicator	Observable Behavior
Consciousness and Attitude	Awareness	Perception and application awareness of technology and information. An open attitude towards new technologies and tools, confident attitude when using ICT tools and solving problems, and responsible actions when using ICT.
	Attitude	Ethical norms and legal regulations that should be followed when using ICT.
Social Responsibility	Ethics and law	Using ICT tools to ensure cyber security, data privacy protection, and prevention of information leakage.
	Cyber security	Basic concepts and knowledge systems in the ICT field.
Knowledge and Skills	Knowledge	Device operation, software application, internet and network usage, device maintenance and troubleshooting, and safe operation.
	Operation	Collecting, filtering, and retrieving information in a technological environment.
	Access	Storing information in an organized structure or

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Primary Indicator	Secondary Indicator	Observable Behavior
		classification for reuse or retrieval.
Thinking and Behavior	Management and organization	Comparing, summarizing, and synthesizing information from multiple channels through ICT tools to reasonably interpret information.
Thinking and Behavior	Integration	Judging the quality, reliability, relevance, usefulness, and effectiveness of information.
	Evaluation	The ability to apply ICT skills and knowledge to solve specific problems, complete specific tasks, or create new value.
Professional Thinking and Vocational Competence	Application	The ability to effectively communicate and present information using ICT tools, including choosing appropriate methods and tools for presentation, and ensuring clear and effective information delivery.
	Presentation	Choosing appropriate tools, media, and creating suitable content for information sharing and exchange according to the audience.
	Communication	Efficiently collaborating with others using ICT tools and platforms.
	Collaboration	Using ICT tools and resources to identify, analyze, and solve problems, as well as evaluate solutions.
	Presentation	Choosing appropriate tools, media, and creating suitable content for information sharing and exchange according to the audience.
	Problem-solving	Designing and producing new or improved products, services, or solutions using ICT tools and resources.
	Creation	Perception and application awareness of technology and information: An open attitude towards new technologies and tools, confident attitude when using ICT tools and solving problems, and responsible actions when using ICT.

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2. Development of Information and Communication Technology Literacy Evaluation Model for Vocational College Students in Guangxi.

After two rounds of Delphi questionnaire evaluations by 21 experts and making modifications based on their feedback, a total of 6 items were revised. This resulted in the ICT Literacy Evaluation model comprising 5 main elements and 27 sub-elements.

According to expert opinions, "Knowledge and Skills" is revised to "Knowledge and General Skills", and "Thinking and Behavior" is revised to "General Thinking and Behavior", in order to differentiate from "Professional Thinking and Vocational Competence" and ensure the highlighting of vocational development aspects of information literacy among higher vocational students. The specific model is illustrated in the diagram below:

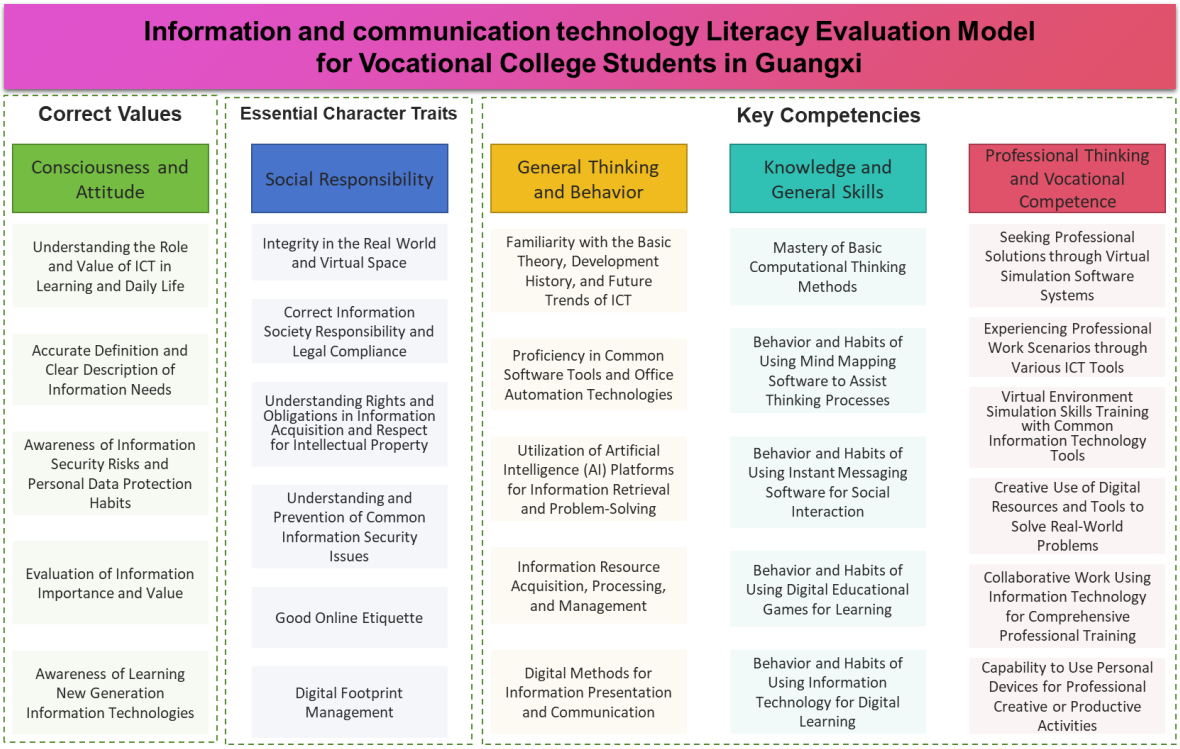

Figure 1 Information and Communication Technology Literacy Evaluation Model for Vocational College Students in Guangxi

Consciousness and Attitude

Understanding the Role and Value of ICT in Learning and Daily Life: Students should understand the role and value of Information and Communication Technology (ICT) in both their learning and daily life.

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Accurate Definition and Clear Description of Information Needs: Students should be able to precisely define the information they require and clearly articulate their information needs.

Awareness of Information Security Risks and Personal Data Protection Habits: Students should possess an awareness of information security risks and maintain habits for protecting their personal information.

Evaluation of Information Importance and Value: Students should be capable of assessing the importance and value of the information they encounter.

Awareness of Learning New Generation Information Technologies: Students should demonstrate an awareness of and a willingness to learn new generation information technologies.

Social Responsibility

Integrity in the Real World and Virtual Space: Students should act with integrity in both the real world and virtual spaces, avoiding any form of online dishonesty.

Correct Information Society Responsibility and Legal Compliance: Students should develop a correct sense of responsibility in the information society, learning and adhering to relevant laws and regulations regarding information activities.

Understanding Rights and Obligations in Information Acquisition and Respect for Intellectual Property: Students should know their rights and obligations when acquiring information and respect intellectual property rights.

Understanding and Prevention of Common Information Security Issues: Students should be aware of common information security issues and possess the skills to protect themselves against them.

Good Online Etiquette: Students should demonstrate good online etiquette, such as using civil language, sharing appropriately, forwarding cautiously, and managing their time effectively.

Digital Footprint Management: Students should manage their digital footprints by carefully publishing content, monitoring their personal online image, and regularly cleaning up their digital traces.

Knowledge and General Skills

Familiarity with the Basic Theory, Development History, and Future Trends of ICT: Students should be familiar with the basic theory, development history, and future trends of Information and Communication Technology (ICT).

Proficiency in Common Software Tools and Office Automation Technologies: Students should master commonly used software tools and office automation technologies

Utilization of Artificial Intelligence (AI) Platforms for Information Retrieval and Problem-Solving: Students should be able to use artificial intelligence (AI) platforms to assist in information retrieval and problem-solving

Information Resource Acquisition, Processing, and Management: Students should be capable of acquiring, processing, and managing information resources

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Digital Methods for Information Presentation and Communication: Students should be able to present and communicate information through various digital means

General Thinking and Behavior

Mastery of Basic Computational Thinking Methods: Students should master the basic methods of computational thinking and be able to use them to approach problem-solving.

Behavior and Habits of Using Mind Mapping Software to Assist Thinking Processes: Students should develop the behavior and habits of using mind mapping software to assist in their thinking processes.

Behavior and Habits of Using Instant Messaging Software for Social Interaction: Students should develop the behavior and habits of using instant messaging software for social interaction.

Behavior and Habits of Using Digital Educational Games for Learning: Students should develop the behavior and habits of using digital educational games for learning.

Behavior and Habits of Using Information Technology for Digital Learning: Students should develop the behavior and habits of using information technology for digital learning.

Professional Thinking and Vocational Competence

Seeking Professional Solutions through Virtual Simulation Software Systems: Students should be able to use virtual simulation and other software systems to seek solutions for professional problems.

Experiencing Professional Work Scenarios through Various ICT Tools: Students should be able to use various ICT tools to observe and experience relevant professional work scenarios.

Virtual Environment Simulation Skills Training with Common Information Technology Tools: Students should be capable of using common information technology tools for simulation skills training in virtual environments.

Creative Use of Digital Resources and Tools to Solve Real-World Problems: Students should creatively use digital resources and tools to solve real-world problems.

Collaborative Work Using Information Technology for Comprehensive Professional Training: Students should be able to use information technology for collaborative work to complete comprehensive training for professional competencies.

Capability to Use Personal Devices for Professional Creative or Productive Activities: Students should possess the capability to use personal devices (such as smartphones or computers) for professional-related creative or productive activities.

Discussion

The study of the ICT literacy evaluation model for vocational students in Guangxi led to the following findings:

The elements of the ICT literacy evaluation model for vocational students in Guangxi include consciousness and attitude, social responsibility, knowledge and general skills, general thinking and behavior, professional thinking and vocational competence. These elements form a

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comprehensive system for cultivating students' ICT literacy. The students' proficiency in utilizing information technology to resolve difficulties, as well as their conscientiousness in cyberspace, contribute to the enhancement of their education (Zhu et al., 2021; Deil-Amen, 2011). This system not only helps to enhance students' abilities in acquiring, understanding, judging, and sharing digital information, but also improves their overall qualities in maintaining digital information security and problem-solving. Digital literacy of the students in vocational education enhances their study (Peng et al., 2023). Furthermore, these elements emphasize the cultivation of students' social responsibility and vocational competence in the information society, enabling them to better adapt to and face future professional challenges, as well as develop high-quality technical skills for their future career development. Through this evaluation model, educators can more effectively formulate and implement ICT literacy education programs, helping students to stand out in the information society and make positive contributions to social and economic development.

The impact and benefit from this study can provide targeted insights that address the specific needs of vocational students in Guangxi. This can lead to the development of more effective teaching methodologies and materials, thereby improving students' digital abilities and preparing them for the workforce. Furthermore, developing a specific ICT literacy evaluation model can standardize assessment methods, ensuring that students' competencies are consistently and accurately measured. ICT education in Guangxi vocational colleges can advance as a result, helping educators and policymakers make better-informed decisions about curriculum development and educational policies.

Recommendation

Throughout the research process, the researchers emphasized the importance of enhancing the cultivation of Social Responsibility, Professional Thinking, and Vocational Competence among vocational students to ensure they can meet the demands of modern industry and contemporary society.

Understanding the Role and Value of ICT in Learning and Daily Life, Awareness of Learning New Generation Information Technologies, and Digital Footprint Management are considered key sub-factors that influence the ICT literacy of vocational students, among all other sub-elements. The key components of core literacy in the information technology discipline for vocational students include Knowledge and General Skills, General Thinking and Behavior, Professional Thinking, and Vocational Competence. We can prioritize and develop these factors based on the unique circumstances of vocational students across various majors and regions.

By focusing on these critical elements and sub-factors, educators can effectively enhance vocational students' ICT literacy, enabling them to thrive in an increasingly digital world. This targeted approach not only supports the students' academic and professional growth but also contributes positively to broader social and economic development.

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