The Impact of Perceived Teacher IT Use on Information Literacy among Chinese Secondary School Students

Xiaorui Chen

Dhurakij Pundit University, Bangkok, Thailand
Shenzhen Huaqiang Vocational and Technical School, Shenzhen, China
Email: x8i8a8o8@126.com

Abstract—This study was conducted to explore the relationship between secondary school students' perceived teacher use of Information and Communication Technology (ICT) and their information literacy. The research used three scales to assess 502 students in vocational and technical schools in Shenzhen: The Information Technology Application Scale for Primary and Secondary School Teachers Scale, the ICT Self-Efficacy Scale, and the Information Literacy Scale for Secondary School Students Scale. The results indicated that male students had a significantly higher ability to share information than female students, and students' perceived use of ICT for teaching and learning varied significantly based on the amount of time they spent using information devices. The study also found that teachers' ICT self-efficacy, their use of ICT for student learning, and their collaboration with other teachers were positive predictors of students' information literacy. On the other hand, teachers' use of ICT for teaching and learning was a negative predictor of students' information literacy. Additionally, the results showed that perceived ICT use had a positive and significant impact on students' information literacy, and that perceived teacher ICT use had a positive and significant effect on ICT self-efficacy, which in turn partially mediated the relationship between perceived teacher ICT use and students' information literacy.

Keywords—ICT self-efficacy, information technology, information literacy

I. INTRODUCTION

Information literacy is a necessary skill for all members of society in the information age, and a necessary condition for the development of vocational ability of secondary school students. The Ministry of Education of the People's Republic of China has issued the "Essentials of Education Informatization and Network Security Work in 2020", which states that teaching applications will cover all teachers, learning applications will cover all students at school age, digital campus construction will cover all schools, and the level of information technology applications and information literacy of teachers and students will be generally improved [1]. Today, with the rapid development of information technology, having certain information literacy has become the most basic requirement for students in the information society [2]. Secondary school students cannot live without all kinds of information digital devices, how to accurately understand and use this digital information to create material conditions for vocational education. Combining advanced information resources with vocational education training objectives can improve the information literacy of secondary vocational students [3]. Therefore, it is important to explore how the information literacy of secondary school students can be improved.

Student information literacy refers to the development of the aggregation of students' abilities to identify problems in learning and life, to determine the information needed to solve them, to identify sources of access to information, to retrieve information, to use information, to evaluate and organize information, and to use information critically in problem solving. The understanding of the information literacy community of students referred to in this study is based on this definition.

Shenzhen, China, was chosen as the study area because it is an emerging first-tier city in China, and its education has certain influence in China. Exploring the information literacy of secondary school students in Shenzhen will be a reference for first tier and even inland cities in China. Shenzhen, as a pioneering demonstration zone, has placed higher demands on the development of vocational education. The municipal government of Shenzhen attaches great importance to the role of vocational education in supporting the transformation and upgrading of the city's industries, and firmly establishes the concept that "There is no industrial modernization without vocational education modernization" [4]. Chen Qiuming, Director of Shenzhen Education Bureau, said that Shenzhen education should be benchmarked against first-class, plan the top-level design of Shenzhen education, be the pioneer of innovation and development, and improve the quality of education to create a benchmark for people's happiness [5].

Information-based teaching is an effective way to cultivate students' information literacy. Focusing on students' use of information technology in teaching and carrying out independent, research-based, and cooperative learning will be conducive to improving students' information literacy [6]. Computer self-efficacy refers to people's basic predictions about the learning activities they will perform in the online environment to complete their learning tasks, and it is a subjective judgment that this activity will be successful [7]. The strength of beliefs about IT self-efficacy affects the completion of IT tasks, with individuals with high performance expectations having a greater chance of success in characteristic tasks [8]. Teachers' attitudes toward computers are strongly related to their use of computers in the classroom and whether they benefit from teacher development and training programs [9, 10]. Improving teachers' IT application skills, as well as students' ICT awareness, is a good way to develop high quality human resources [11]. Students' internal psychological motivation variables can explain the impact of external learning environment variables on students [12].

Teachers' IT application and ICT self-efficacy are factors that influence students' information literacy and there may be a mediating role for ICT self-efficacy [13]. The strength of beliefs about IT self-efficacy affects the completion of IT tasks, and individuals with high performance expectations have a greater chance of success in characteristic tasks [14]. Teachers' computer uses in the classroom and their ability to benefit from teacher development and training programmes are strongly related to their attitudes towards computers [15]. Positive attitudes such as teachers' attitudes towards computers can facilitate the integration of IT into the curriculum and improve the quality of teachers' use of computers for teaching and learning [16].

It is clear from previous research that perceived teacher IT use not only affects students' information literacy directly, but also indirectly through motivational variables such as ICT self-efficacy. Among the studies related to perceived teachers' IT applications, students' information literacy and ICT self-efficacy, only studies on teachers' attitudes towards IT, teachers' self-efficacy, and students in general universities have been conducted, and there are relatively few studies on secondary students' information literacy, and the dimensions are relatively homogeneous. To better understand the situation related to information literacy of secondary school students, this study explored the influence and mechanism of action of secondary school students' perceived teachers' IT applications (environmental factors) and ICT self-efficacy (individual factors) on students' information literacy.

To address the gap of previous studies, this study selected secondary school students as the research subjects. This study also referred to the Information Literacy Scale for Secondary School Students Scale [17]. This scale is divided into six dimensions: the ability to identify problems, the ability to seek information, the ability to retrieve information, the ability to use information, the ability to synthesize information, and the ability to evaluate information. Using this scale to explore the information literacy of secondary school students, and through the use of statistical methods such as correlation and regression with the analysis of perceived teachers' information technology applications and students' ICT self-efficacy, it is concluded that secondary students' information literacy is influenced by both perceived teacher IT applications and ICT self-efficacy, and therefore offers constructive comments on the findings that can help improve secondary students' information literacy.

II. RESEARCH HYPOTHESIS

Perceived teacher IT refers to the teaching applications that IT teachers develop in their educational and teaching practices that can be perceived by students, based on IT teaching work and the accomplishment of teaching objectives [18]. Perceived teacher IT applications affect teachers' teaching behavior, teaching effectiveness to a certain extent, and are related to teachers' professional growth and the level of their mediating effect on students' self-efficacy, which is crucial to students' future growth and development [19].

In the secondary student population, perceived teacher IT applications have different effects on information literacy. Perceived teacher IT applications will, on the one hand, contribute to individual secondary students' sense of achievement, motivation, and self-confidence in learning; on the other hand, it will enhance individual secondary students' self-efficacy [20].

ICT self-efficacy refers to individuals' self-perceptions of their ability to use ICT, including computer self-efficacy and network self-efficacy [21]. Later studies have explored ICT self-efficacy and student learning in more depth; for example, some scholars have mentioned that a stronger sense of computer efficacy can lead to a strong desire to learn among university students [22]. Enhancing computer self-efficacy and improving IT literacy as well as becoming an important topic of research in universities, the ability to learn independently in the network environment is a necessary skill for students. Improving students' computer self-efficacy is also an important parameter for measuring the quality of teaching in universities and better responding to the requirements of the information technology education era [23].

This study is based on secondary school students in Shenzhen. Most previous studies have focused on students in general universities. This study has a strong focus on the target population, by extrapolation, it has reference value to the current situation of information literacy of secondary school students in first-tier cities in China.

In view of this, this study included ICT self-efficacy as a mediating variable to explore the relationship between ICT self-efficacy in secondary school students' perceptions of teachers' IT applications and high

information literacy. The following hypotheses were proposed.

Hypothesis 1: Perceived teacher IT applications have a positive effect on students' information literacy.

Hypothesis 2: Perceived teacher IT applications have a positive effect on ICT self-efficacy.

Hypothesis 3: ICT self-efficacy has a positive impact on students' information literacy.

Hypothesis 4: Perceived teacher IT use mediates students' information literacy through ICT self-efficacy.

III. RESEARCH OBJECT

In this study, 600 questionnaires were distributed to students in vocational and technical schools in Shenzhen, and 600 questionnaires were returned, with a return rate of 100%. Excluding the questionnaires with missing answers and those with only the same options, we obtained 502 valid questionnaires, with an effective rate of 83.7%. Among the respondents, Table I shows there were 257 male students (51.2%) and 245 female students (48.8%); 152 senior students (30.3%); 172 senior students (34.3%); 178 senior students (35.5%); 45 students (9.0%) used information devices for 1–2 hours; 156 students (31.1%) used information devices for 3–4 hours; 203 students (40.4%) used information devices for 5–6 hours. (40.4%); 98 people (19.5%) used more hours. The results are shown in Table I.

TABLE I. BACKGROUND INFORMATION GENDER STATISTICS TABLE

Gender	Number of times	One Hundred percent	Cumulative percentage
Male	257	51.2	51.2
Female	245	48.8	100.0
Total	502	100.0	

Table II shows that, at the grade level, 152 (30.3%) of the respondents were seniors, 172 (34.3%) were juniors, and 178 (35.5%) were seniors. This shows that most of the respondents in this study were seniors and juniors, and that the number of students in each grade was almost equal.

TABLE II. BACKGROUND INFORMATION GRADE STATISTICS

Grade Level	Number of times	One Hundred percent	Cumulative percentage
Senior 1	152	30.3	30.3
Senior 2	172	34.3	64.6
Senior 3	178	35.5	100.0
Total	502	100.0	

TABLE III. STATISTICS ON THE LENGTH OF TIME INFORMATION DEVICES ARE USED FOR BACKGROUND INFORMATION

Hours of using information equipment	Number of times	One Hundred percent	Cumulative percentage
1–2 hours	45	9	9
3–4 hours	156	31.1	40.1
5–6 hours	203	40.4	80.5
More	98	19.5	100.0
Total	502	100.0	

Table III shows that 45 respondents (9.0%) used information devices for 1–2 hours, 156 (31.1%) for 3–4 hours, 203 (40.4%) for 5–6 hours and 98 (19.5%) for more hours. This shows that the largest number of respondents use information devices for 5–6 hours and the smallest number use 1–2 hours.

IV. MATERIALS AND METHODS

A. Research Instruments

This study used a questionnaire to collect research data. In addition to the basic information, three scales were included in this study: the first one was the "Information Technology Application Scale for Primary and Secondary School Teachers"; the second one was the "ICT Self-Efficacy Scale"; and the third one was the "Information Literacy Scale for Students".

Table IV shows the Information Technology Application Scale is a modification of the scale from the 2013 International Computer and Information Literacy Study (ICILS) project initiated by the International Association for the Evaluation of Educational Achievement (IEA) [24]. The design has 37 question items divided into six dimensions, for example, "The teacher is able to search and find documents on the computer". Both the Cronbach's alpha and the combined reliability are greater than 0.8, which meets the reliability test, and the CITC index is between 0.68 and 0.77.

TABLE IV. DIMENSIONS OF THE INFORMATION TECHNOLOGY APPLICATION SCALE

Dimensionality	Subscales	Dimension name	Items Number
1	Teacher ICT Self-Efficacy Scale	Teacher ICT self-efficacy	9
2	Teacher Use of ICT for Teaching	Teachers' use of ICT for teaching and student learning	8
3	Teacher Use of ICT for Student	Teachers' use of ICT for teaching and learning	7
4	Scale of teachers' positive attitudes towards the use of ICT in teaching	Teachers' positive attitudes towards the use of ICT in teaching	6
5	Scale of teachers' negative attitudes towards the use of ICT in teaching	Teachers' negative attitudes towards the use of ICT in teaching	5
6	Scale of teachers' use of ICT in collaboration with other teachers in teaching	Teachers' use of ICT in collaboration with other teachers in teaching	4

Table V shows the Information Literacy Scale for Secondary School Students Scale is based on the Information Literacy Scale for Secondary School Students [25] developed by Taiwanese scholar Xu and is designed with 30 questions divided into six dimensions, for example, "I can identify problems in my life or in my studies". The reliability of this scale is acceptable, with a Cronbach's alpha value of 0.941 and a CITC index ranging from 0.54 to 0.63.

TABLE V.   DIMENSIONS OF THE INFORMATION LITERACY SCALE FOR SECONDARY SCHOOL STUDENTS SCALE

Dimensionality	Subscales	Dimension name	Items Number
1	Ability to identify issues subscale	Ability to identify problems	6
2	Information seeking ability subscale	Ability to seek information	4
3	Ability to retrieve information subscale	Ability to retrieve information	5
4	Ability to use information subscale	Ability to use information	5
5	Ability to synthesize information subscale	Ability to synthesize information	6
6	Ability to assess information subscale	Ability to assess information	4

Table VI shows the dimensions of the ICT self-efficacy scale. The scale measures borrowed from the Computer Self-Efficacy Scale developed by Wang [26] and was designed with 16 questions divided into 3 dimensions, for example, "I would be happy to demonstrate to the class the computer task I have just learned in this class". The reliability of this scale is acceptable, with a Cronbach's alpha value of 0.959, and a CITC index between 0.49 and 0.89.

TABLE VI.   ICT SELF-EFFICACY SCALE DIMENSIONS

Dimensionality	Subscales	Dimension name	Items Number
1	Quantitative subscales	Quantitative	6
2	Strength subscale	Strength	5
3	Generalization subscale	Generalization	5

B. Data Analysis

In this study, to explore the relationship between the three variables of perceived teacher IT use, ICT self-efficacy, and student information literacy, the statistical software SPSS 23.0 was used to detect the relationship between the three variables using correlation analysis, regression analysis, and mediating effects.

1) Correlation analysis

The correlation analysis of the three variables of student information literacy, perceived teacher IT application, and ICT self-efficacy revealed (see Table VII for details) that student information literacy, perceived teacher IT application, and ICT self-efficacy were all significantly correlated, and the correlation coefficients were all greater than 0, so they were all positively correlated. The correlation coefficients did not exceed 0.8, meaning that there was no co-linearity between the variables, which is a low to medium correlation and suitable for the next step of regression analysis.

TABLE VII.   CORRELATION ANALYSIS TABLE FOR EACH DIMENSION

Relevance	Sense1	Sense 2	Sense 3	Sense 4	Sense 5	Sense 6	ICT1	ICT2	ICT3	LB
Sense 1	1									
Sense 2	0.420**	1								
Sense 3	0.417**	0.457**	1							
Sense 4	0.465**	0.493**	0.406**	1						
Sense 5	0.465**	0.399**	0.448**	0.431**	1					
Sense 6	0.580**	0.582**	0.614**	0.691**	0.674**	1				
ICT1	0.471**	0.486**	0.477**	0.519**	0.495**	0.697**	1			
ICT2	0.391**	0.468**	0.426**	0.484**	0.463**	0.593**	0.562**	1		
ICT3	0.452**	0.492**	0.477**	0.485**	0.461**	0.618**	0.527**	0.560**	1	
LB	0.602**	0.596**	0.568**	0.617**	0.625**	0.669**	0.690**	0.599**	0.663**	1

Note 1: *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.
Note 2: Sense 1 refers to teachers' ICT use, sense 2 refers to teachers' use of ICT for students, sense 3 refers to teachers' use of ICT for teaching, sense 4 refers to teachers' positive ICT attitudes, sense 5 refers to teachers' negative ICT attitudes, sense 6 refers to inter-teacher collaboration. ICT1 refers to quantity, ICT2 refers to intensity, ICT3 refers to generalization, and LB refers to students' information literacy.

2) Regression analysis

The regression analysis used in this study was a forced entry method. Table VIII shows that there was a significant positive effect of teachers' ICT self-efficacy, teachers' use of ICT for student learning, teachers' use of ICT for teaching, inter-teacher collaboration, quantity, intensity, and probability, i.e., Hypothesis 1 and Hypothesis 3 were supported. r^2 was 73.4%, therefore teachers' ICT self-efficacy, teachers' use of ICT for student learning, teachers' use of ICT for teaching, inter-teacher collaboration, quantity, intensity, generalization, and teachers' use of ICT for teaching explained 73.4% of students' information literacy.

TABLE VIII.   REGRESSION ANALYSIS OF THE DIMENSIONS OF PERCEIVED TEACHER IT USE, ICT SELF-EFFICACY ON STUDENTS' INFORMATION LITERACY

Self-variable items	β	t
Sense 1	0.147	5.039***
Sense 2	0.118	3.940***
Sense 3	0.014	0.321***
Sense 4	0.015	0.284
Sense 5	0.048	0.972
Sense 6	0.351	3.326**
ICT1	0.174	4.926***
ICT2	0.069	2.185*
ICT3	0.183	5.756***
F		150.929***
R²		0.734
△R²		0.729

Note: *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

3) Mediating effects

Since the study variables did not differ significantly in terms of demographic variables, the effect of demographic variables was excluded from the regression analysis. Table IX shows that Model 1, with perceived IT application as the dependent variable and student information literacy as the independent variable, found that perceived IT application had a positive and significant effect on student information literacy ($\beta = 0.823$, $p = 0.001$), and research hypothesis 1 was supported. Model 2, with perceived teacher IT application as the dependent variable and ICT self-efficacy as the independent variable, found that perceived teacher IT application had a positive and significant effect on ICT self-efficacy ($\beta = 0.778$, $p = 0.001$), research hypothesis 2 was supported. Perceived teacher IT application and ICT self-efficacy were entered into the regression equation at the same time, and it was found that perceived teacher IT application had a decreased predictive power on students' information literacy when ICT self-efficacy was added ($\beta = 0.546$, $p = 0.001$), hypothesis 4 was supported. Also, ICT self-efficacy significantly influenced student information literacy ($\beta = 0.356$, $p = 0.001$) Hypothesis 3 was supported. The results suggest a partial mediating effect of ICT self-efficacy between perceived teacher IT use and student information literacy.

TABLE IX.　EFFECT OF PERCEIVED TEACHER IT USE ON STUDENTS' INFORMATION LITERACY THROUGH ICT SELF-EFFICACY

	Model1	Model2	Model3
Variable items	perceived teacher IT use	ICT self-efficacy	Student Information Literacy
	Beta	Beta	Beta
Self-variable items			
perceived teacher IT use	0.823***	0.778***	0.546***
Intermediary variables			
ICT self-efficacy			0.356***
F-value	1046.085***	764.974***	663.066***
△R2	0.677	0.604	0.725
R2	0.676	0.605	0.727

Note: ***: $p < 0.001$.

C. Validation of the Study Model

The results of the pathway analysis for this study are as follows.

TABLE X.　SUMMARY TABLE OF MODEL REGRESSION COEFFICIENTS

X	Y	Non-normalized path coefficients	SE	CR value	P	Standardized path coefficients
ICT self-efficacy	Student Information Literacy	0.624	0.0659	0.586	0.000	0.356
Perceived teacher IT use	Student Information Literacy	0.439	0.03014	0.707	0.000	0.546
Perceived teacher IT use	ICT self-efficacy	0.357	0.01327	0.712	0.000	0.778

From Table X, we know that the standardized path coefficient value is $0.356 > 0$ when ICT self-efficacy has

an impact on students' information literacy, and this path shows a 0.01 level of significance ($z = 9.586$, $p = 0.000 < 0.01$), thus indicating that ICT self-efficacy has a significant positive impact on students' information literacy.
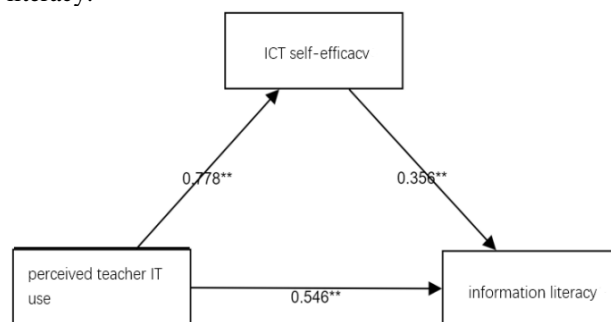

Figure 1.　Path regression model.

Fig. 1 shows path regression model results. The standardized path coefficient value of $0.546 > 0$ for the effect of teachers' IT applications on students' information literacy is seen in Fig. 1, and this path shows a significant level of 0.01 ($z = 14.707$, $p = 0.000 < 0.01$), thus indicating that teachers' IT applications have a significant positive effect on students' information literacy. The standardized path coefficient value of $0.778 > 0$ was found to be significant at the 0.01 level ($z = 27.712$, $p = 0.000 < 0.01$), thus indicating that teachers' IT applications have a significant positive impact on ICT self-efficacy.

TABLE XI.　PATH ANALYSIS TABLE

Research Hypothesis	Path factor	Results
H1 Perceived positive impact of teachers' IT use on students' information literacy	0.356	Established
H2 Perceived positive impact of teachers' IT use on ICT self-efficacy	0.546	Established
H3 ICT self-efficacy has a positive impact on students' information literacy	0.778	Established
H4 ICT self-efficacy mediates students' information literacy through perceived teacher IT use	——	Established

From Table XI, the current research model is credible, reliable, and correct. Hypotheses H1, H2, and H3 were corroborated in the path analysis, while H4 was tested in the mediating effect to conclude that ICT self-efficacy partially mediates students' information literacy through perceived teacher IT applications, thus also validating the hypothesis.

V. RESULTS

A. Perceived Teacher IT Use Has a Direct Effect on Students' Information Literacy

Although perceived teacher IT applications positively influenced students' information literacy, previous research has focused on factors such as students' own

motivation and interest in learning but neglected the role of learning perception in students' information literacy, which may be related to the characteristics of secondary school students. Secondary school students have more serious anxiety in learning, and they are less likely to take the initiative to give feedback to teachers when they have questions in class, making it difficult for teachers to change teaching strategies.

B. Perceived Teacher IT Use Has a Direct Impact on ICT Self-Efficacy

Perceived teacher IT application positively influences ICT self-efficacy, indicating that although ICT self-efficacy stems from the judgment of one's own ability to accomplish a certain behavior on ICT, it is also influenced by the surrounding environment. Perceived teacher IT application has a stronger positive influence on secondary school students' ICT self-efficacy, which may be related to perceived power and individual cognitive differences. On the one hand, perceived teacher IT use is a test of secondary school students' ability to comprehend "learning" in the classroom and the judgment of the teacher's attitude towards "teaching" in the teaching; on the other hand, there were also differences in the ability of secondary school students to translate what they were taught in class into a sense of self-efficacy that they could consistently apply to their learning.

C. ICT Self-Efficacy Plays the Role of a Mediating Variable

ICT self-efficacy played a partially mediating role between perceived teacher IT use and student information literacy, with the mediating effect accounting for 77.3% of the total effect, i.e., perceived teacher IT use had an indirect effect on student information literacy. With high ICT self-efficacy, the more helpful students perceived teacher IT applications to be to their information literacy, and conversely, the less helpful.

VI. DISCUSSION

The results of the study showed that secondary school students perceived that teachers' IT applications had a significant impact on information literacy and could also indirectly influence information literacy through ICT self-efficacy. Based on the above empirical results, this study suggests that secondary school students can consider the following aspects to improve their information literacy.

A. Strengthen the Construction and Application of Information Technology Resources to Enhance Students' Perception of Information Technology Application

This study finds that perceived teachers' information technology applications have some influence on students' information literacy. To enhance students' information literacy, teachers' IT skills and access to educational resources must also be in place. Secondary vocational schools have basically achieved partial popularity of online resources such as micro-course resources and high-quality courses, purchased or built their own campus network management platform, online teaching platform and other information technology application facilities. Most schools have basically built one or more virtual simulation laboratories [27]. However, the utilization rate of information technology resources and teaching platforms in many schools is low, and students are unable to effectively use digital learning resources and are less exposed to online teaching platforms, which seriously affects the cultivation of students' information awareness and skills [28]. In response to the above problems, firstly, schools should constantly optimize their online resource management platforms to allow students to access and use digital learning resources conveniently, while in the process of building digital resources they should focus on the long-term development of students and actively build some informational resources and tools that are beneficial to their career development. Secondly, teachers should pay attention to guiding students to use information technology resources and encourage them to cooperate and communicate through the online teaching platform. At the same time, teachers should actively use information technology tools and platforms to explore information technology teaching methods in the daily teaching process, strengthen the deep integration of information technology and practical teaching, so that students gradually become interested in information technology learning methods and thus constantly guide students to consciously use network technology to search for information and solve practical problems, forming independent learning ability.

B. Strengthen Students' Perception of the Effects of Teachers' IT Applications and Enhance Their IT Skills

Students' perceptions of teachers' IT applications have an impact on ICT self-efficacy.

For policy makers to recognize the mechanisms inherent in the impact of perceived teacher IT applications on students' information literacy, relevant policies can give more consideration to strengthening students' application of what they have learned in the classroom. For example, information literacy training can be conducted to enhance students' application of information skills. By conducting or organizing information skills training and learning for students, students' confidence in using ICT can be increased and their interest in learning about information can be stimulated to a certain extent, which can help them to quickly and effectively acquire the information technology skills required for employment positions. Therefore, schools should vigorously develop information literacy training, create a favorable environment and conditions to realize the training of information technology talents, or encourage students to participate more in relevant competitions carried out by other social organizations, and develop a series of incentive measures. At the same time, school teachers should provide guidance, solving difficulties for students and build a good learning environment.

C. Enhance Self-Awareness and Improve ICT Self-Efficacy

The impact of perceived teachers' information technology application will not have a high impact on students' information literacy. The main impact is students' ICT self-efficacy, and when students' ICT self-efficacy is higher, the more helpful it is to learn and the more they can improve their information literacy. Therefore, secondary students should break through themselves and let go of the learning anxiety in their hearts. They should actively participate in various skills training and activities that are conducive to ICT enhancement and improve their abilities in practice, thereby enhancing their ICT confidence and improving their self-efficacy. Individuals will only take action to improve their academic achievement once they have developed the need to master knowledge and skills and transformed it into motivation [29]. Schools and teachers should not focus only on students' knowledge and skills but neglect psychological issues. They should focus on all three at the same time and assess them regularly to encourage students to improve.

VII. CONCLUSIONS

This study explored the relationship between perceived teacher IT application, information literacy and ICT self-efficacy among Chinese secondary school students through a questionnaire survey. The results showed that perceived teachers' IT use significantly and positively influenced information literacy; ICT self-efficacy partially mediated the relationship between perceived teachers' IT use and information literacy. Therefore, we should pay more attention to the shortcomings of "teaching" and "learning" in secondary schools and improve them accordingly, to enhance students' enthusiasm and self-efficacy for learning. Secondly, students' self-efficacy in learning should be improved. With a good sense of self-efficacy, students will be able to support their active learning and serious investigation, and they will be in a happy learning atmosphere, thus becoming more confident and optimistic, and improving their own literacy.

Of course, there are still limitations in this study. In terms of statistical methods, this study only used t-test, one-way analysis of variance, linear regression and exploring the relationship paths between the variables. Therefore, it is suggested that future studies should start with different contextual variables and explore their relationship with perceived teachers' IT application, ICT self-efficacy and students' information literacy, to increase the depth and breadth of the study.

APPENDIX QUESTIONNAIRE

Dear students:

Hello! Thank you very much for taking the time to complete this questionnaire.

This questionnaire is for academic research purposes only and will be completed anonymously, with full confidentiality guaranteed. There are no good or bad answers, right or wrong, so please make your own choice on the appropriate item and tick the most appropriate option for each question. To ensure the validity of the questionnaire, each question in the questionnaire must be answered, and only one answer must be chosen for each question, do not select more than one and do not miss any. Thank you very much for your cooperation! Thank you very much for your cooperation and help, and good luck with your studies!

Please start by answering your basic questions and tick the boxes that best suit your actual situation.
1. Your gender Male Female
2. Your grade Senior ____ Senior _____ Senior ____
3. Your major
4. the number of hours you use information technology devices per day 0 hours__ 1–2 hours__ 3–4 hours__ 5–6 hours___ more___
Completely disagree
Disagree
Not sure
Agree
Completely agree

Part I: Information Technology Use Scale for Primary and Secondary School Teachers (Student Paper).

Respond to your own truth by ticking the appropriate option √ Completely disagree Disagree Not sure Agree Completely agree

1 The teacher is able to search and find documents on the computer.
2 The teacher is able to add files as email attachments on the computer and send them.
3 The teacher can store digital photos on the computer.
4 The teacher can archive files in folders and sub-folders.
5 The teacher can record and analyze data using spreadsheets (e.g., Excel).
6 The teacher is able to participate in communication and discussion online.
7 The teacher is able to shop and pay online.
8 In the computer room class, the teacher asked me to use IT in some of the course tasks.
9 In the computer room class, I use IT to communicate and discuss with other students.
10 In the computer room class, I use IT for inquiry-based learning or investigation.
12 In the computer room class, I use IT to summarize my learning experiences.
12 In the computer room class, I use IT to communicate with students from other schools.
13 In the computer room class, I use IT to communicate with students from other schools.
14 In the computer room class, I use IT to plan learning activities.
15 In the computer room class, I search for information on a topic through a search engine.
16 The teacher uses IT to support student-led class discussions and presentations.

17 The teacher uses IT tests to assess my learning.

18 The teacher uses IT to provide me with feedback.

19 The teacher uses IT to help me practice to enhance my skills.

20 My teacher uses IT to facilitate communication and exchange with foreign experts.

21 The teacher uses IT to facilitate collaboration with my classmates.

22 My teacher uses IT to work with parents to support my learning.

23 The teacher believes that the use of IT in teaching and learning is effective in helping me to consolidate and process information.

24 The teacher believes that the use of IT in teaching and learning helps me to work collaboratively with other students.

25 The teacher believes that the use of IT in teaching and learning enables me to communicate more effectively with others.

26 The teacher believes that the use of IT in teaching and learning will help me to develop a greater interest in learning.

27 The teacher believes that the use of IT in teaching and learning helps me to tailor my learning to my own learning needs.

28 The teacher believes that the use of IT in teaching and learning will help me to develop skills in planning my learning and independent learning.

29 The teacher believes that the application of IT in teaching and learning will result in my writing skills becoming poor.

30 The teacher believes that the application of IT in teaching and learning will only cause problems with the organization and management of the school.

31 The teacher believes that the application of IT in teaching and learning will hinder the formation of concepts because computer images cannot replace actual objects.

32 The teacher believes that the application of IT in teaching and learning will only encourage me to copy materials from the Internet.

33 The teacher believes that the application of IT in teaching and learning will limit personal communication between me and my classmates.

34 The teachers will work together to improve the use of IT in the classroom.

35 There is a set of rules in school about how to use IT in the classroom.

36 Teachers will work together to systematically develop a curriculum for basic IT.

37 The teacher will observe how other teachers use IT in their teaching.

Part 2: Student Information Literacy Scale.

Respond to your own real-life situation by ticking the appropriate box

1 I can identify problems in my life or in my studies.

2 I can write down the problems I need to solve on a piece of paper.

3 I can identify the key to a problem and its focus.

4 I can know what materials to look for based on the problem I need to solve.

5 I can use IT tools to identify key points or keywords for the information I need.

6 I know that there is a wide range of information available on the internet and that there is a lot of useful information to be found.

7 I know that I can find the information I need in the library or elsewhere, in addition to the information on the internet

8 I can write about the various ways in which information can be found.

9 I can choose the best way to find the information I need.

10 I can browse the internet for general information.

11 I can use a search engine on the internet to find the information I need by typing in the keywords of the question.

12 I use IT tools to find the information I need.

13 I know that the library provides information not only in books but also on tapes, videos, CDs, etc.

14 I know how to find more information if it is not enough.

15 I can operate a computer to access materials on the internet.

16 I can use the internet to select the most needed information from a large number of sources.

17 I can read carefully the information I find in a search.

18 I can make simple notes about the information I have found.

19 I respect the intellectual property of others when using materials.

20 I will organize the information I have found in a search into a usable document.

21 I can use word processing software to organize the information I have collected.

22 I will use a printer to print out the collated information.

23 I will create a simple webpage of the information I have collected to provide reference for other students.

24 I will use the internet or email to communicate with other students.

24 I will use the internet or email to share the information I have collated with other students.

25 I will organize a report or assignment after I have collated it and discuss it with my classmates.

26 I will use information technology to improve the weaknesses of my information gathering so that I can gather information more quickly and correctly in the future.

27 I can improve the weaknesses of my work and use it as a reference for my next assignment.

28 I can use the results I have collated flexibly to solve other related and similar problems.

29 I can use information technology to solve problems in my life or studies.

30 I will continue to study IT to improve my information skills.

Part 3: Computer self-efficacy scale.

Respond to the truth about yourself by ticking the appropriate box

1 When I encounter software that helps me learn but that I have never encountered before, I try to use it.

2 When I encounter a computer fault that I have never encountered before, I will try to solve it.

3 For a computer task that I am just learning, I can complete the task if given enough time, even without any help.

4 For a computer task that I have never been exposed to before, I can complete the new task without any help if I have been exposed to a similar computer task before.

5 For a computer task that I have never done myself, if I have seen someone else do it before, then I will be able to complete the new task even without any help.

6 I am worried that I will not be able to do a computer task that I am not familiar with.

7 I do not doubt my poor computer skills because of a single experience of failure in completing a computer task.

8 When working on a computer task with which I am familiar, if a problem arises that I have never encountered before, I am confident that I can solve it.

9 When I perform a computer task that I have never encountered before, if I complete the task with the help of others, then I will be able to complete the task next time in time without any help.

10 When I encounter a computer task that I am not competent at, I will try again after a period of study.

11 When I encounter a computer task that someone with my computer skills is not able to do, I try to complete the task.

12 I can do computer tasks that I am normally able to do just as well in exams.

13 I can do computer tasks that I can do without other people watching me just as well in front of others.

14 For tasks that can be completed using a variety of computer software, I will try to complete the task using different software.

15 If I have done a computer task before with a piece of software I am familiar with, I can also do it with a new piece of software.

16 I would be happy to demonstrate in class the computer task I have just learned in this lesson.

CONFLICT OF INTEREST

The author declares no conflict of interest.

ACKNOWLEDGMENT

REFERENCES

[1] Ministry of Education of the People's Republic of China. (2020). Notice of the General Office of the Ministry of Education on the Release of the Essentials of Education Informatization and Cybersecurity Work in March 2020. [Online]. Available: http://www.moe.gov.cn/s78/A16/s5886/s6381/202004/t20200422_445508.html

[2] F. Yang and X. Zou, "Analysis of the current situation of information literacy among secondary school students," *Software Guide, Educ. Technol.*, no. 2, p. 3, 2012.

[3] Z. Huan and Z. Dequan, "A logical framework for the construction of smart classroom in vocational education in the era of new technology," *China's Electro-Chem. Educ.*, no. 6, pp. 6–13, 2019.

[4] L. Mian, "Shenzhen promotes vocational education to support urban industrial transformation and upgrading to create world-class vocational education," *China Development*, no. 86, pp. 56–68, 2022.

[5] F. Liu. Building a nest to attract phoenixes Shenzhen to build a charming city. *China Youth Daily*. [Online]. Available: http://news.youth.cn/gn/202010/t20201015_12530664.html

[6] J. Di and W. Gang, *Educational Evaluation and Measurement*, 2nd ed., Education Science Press, 2007.

[7] W. Hui, "Enhancing computer self-efficacy to improve information technology literacy – A pilot study on the cultivation of computer self-efficacy in preschool education," *J. Jiamusi Coll. Educ.*, no. 10, pp. 383–384, 2018.

[8] A. Chow, H. S. Tilney, P. Paraskeva, *et al.*, "The morbidity surrounding reversal of defunctioning ileostomies: A systematic review of 48 studies including 6,107 cases," *Int. J. Colorectal Dis.*, vol. 24, no. 6, pp. 711–723, 2009.

[9] K. A. Kluever and R. Zanibbi, "Balancing usability and security in a video CAPTCHA," in *Proc. 5th Symp. Usable Privacy Security, Mountain View*, CA, USA, Jul. 15–17, 2009, p. 1.

[10] S. Torkzadeh, H. Soltanizadeh, and A. A. Orouji, "Energy-Aware routing considering load balancing for SDN: A minimum graph-based ant colony optimization," *Cluster Comput.*, pp. 1–20, 2021.

[11] G. Jia, "A study on the cultivation of information culture literacy among secondary school students: A case study of some secondary schools in Zhejiang," doctoral dissertation, Zhejiang Normal University, 2010.

[12] C. Fan, "The influence of classroom environment on independent learning and its implications for school education," *Educational Science Forum*, vol. 3, p. 5, 2006.

[13] K. T. Bucher, "The importance of information literacy skills in the middle school curriculum," *The Clearing House*, vol. 73, no. 4, pp. 217–220, 2020.

[14] L. Jiang, Y. Wu, and S. Zhu, "Research on the influencing factors of secondary school students' information literacy level and its mechanism of action," *Chinese Electro-Chemical Education*, vol. 9, p. 7, 2020.

[15] R. Dashtestani and S. Hojatpanah, "Digital literacy of EFL students in a junior high school in Iran: Voices of teachers, students, and Ministry Directors," *Computer Assisted Language Learning*, vol. 35, no. 4, pp. 635–665, 2022.

[16] E. Tewell, "A decade of critical information literacy: A review of the literature," *Communications in Information Literacy*, vol. 9, no. 1, p. 2, 2015.

[17] Y. L. Hsu, "Information literacy and the development of creative thinking in students," *Journal of Education Society*, vol. 12, pp. 33–38, 2005.

[18] K. L. Yu, *Reflecting on Learning: An Important Way to Learn to Learn*, Educational Science Press, 2009, vol. 13, pp. 2–8.

[19] M. Zhu, "A practical study on enhancing teachers' information technology application skills in the future classroom environment," *Literacy, and Numeracy (Teacher's Edition): Quality Education Forum*, vol. 43, p. 1, 2015.

[20] F. Yang, "Analysis of the current situation of information literacy among secondary school students," *Vocational and Technical Education*, vol. 62, pp. 2–4, 2012. https://doi.org/10.16735/j.cnki.jet.2012.02.034

[21] E. Papastergiou, "Perceived self-efficacy and technology proficiency in undergraduate college," *Computer & Education*, vol. 55, pp. 1614–1617, 2010.

[22] X. C. Zhang, "Experimenting with the development of adult self-learning skills," *Social Scientist*, pp. 132–134, 2011.

[23] T. T. Cao, "A study on the factors influencing entrepreneurial self-efficacy and the mechanisms promoting it among liberal arts college students," *Shenzhou (Lower Journal)*, no. 16, 2016.

[24] IEA, "International Computer and Information Literacy Research in 2013," International Association for the Evaluation of Educational Achievement, 2013.

[25] Y. L. Hsu, "Information literacy and the development of creative thinking in students," *J. Educ. Soc.*, no. 12, pp. 33–38, 2005.

[26] J. Wang, "Distribution and application of computer self-efficacy questionnaire for university students," *Open Educ. Res.*, no. 16, pp. 90–97, 2010. https://doi.org/10.13966/j.cnki.kfjyyj.2010.02.012

[27] B. Yu, "Research on the design and application of micro-course of 'Computer Network Fundamentals' for secondary school," *Sci. Informatization*, no. 14, p. 1, 2021.

[28] Y. Zhang, "Research on the application of digital learning resources in junior high school information technology teaching," *Hehe Educ.*, no. 12, p. 1, 2015.

[29] Y. Wang, "A study on the relationship between psychological capital, achievement goal orientation and academic achievement among college students," *Explorations Higher Educ.*, pp. 128–137, 2011.