ORIGINAL RESEARCH PAPER

A consideration of the roles of preservice teachers' information literacy, digital literacy, and ICT self-efficacy in teaching

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ABSTRACT

Background and Objectives: Today, technology has an important role to play in regulating society's lifestyle. People's lives are dominated by an information environment because of rapid technological progress in computers, the Internet, and smartphones. Information and communication technology (ICT) is a special branch of IT facilitating access to information. ICT can help to improve teachers' teaching experiences and prepare them for the demands of the 21st century. To be effective in the use of ICT, teachers are required to have adequate self-efficacy teaching skills. ICT self-efficacy is the concept of an individual's belief that he or she can use information and communication technologies for specific tasks. The skills of information literacy and digital literacy are required for teachers to develop their own ability to use ICT. With this consideration, the relationship between information literacy and digital literacy of preservice teachers and their ability to use ICT for learning purposes is investigated in this study.

Materials and Methods: In this study, a survey research design was employed as the methodology. Data were collected using online questionnaires, and the collected data were analyzed using Confirmatory Factor Analysis (CFA). To gather data for this study, an online survey comprising two questionnaires was administered to students enrolled in teacher training programs at Farhangian University in Zanjan, Iran in 2023. One of the frameworks used as a questionnaire was rigorously developed and validated by Pinto and Markauskaite et al., while the other one was taken from the Global Framework of Reference on Digital Literacy Skills. Participants were chosen from study groups which were selected through stratified cluster sampling. Out of 1700 preservice teachers in two branches of Farhangian University (Alzahra and Shahid Beheshti), 313 preservice teachers were selected as the representatives (which was calculated based on the Morgan Table). To investigate the correlation between latent variables, survey data have been analyzed using CFA. For the evaluation of the proposed framework, structural equation modeling (SEM) was also used.

Findings: The outcomes of the CFA and SEM analysis revealed that how pre-service teachers perceive their information literacy directly and positively affects their perception of digital literacy. Additionally, the results showed that pre-service teachers' perceived information literacy has a direct and positive influence on their self-confidence in using ICT for teaching, also known as ICT self-efficacy. Furthermore, the research findings indicated that the way pre-service teachers perceive their digital literacy directly and positively impacts their self-confidence in utilizing ICT for teaching. However, when compared to perceived digital literacy, the perceived information literacy of preservice teachers has a more pronounced effect on their ICT self-efficacy in the context of teaching.

Conclusions: The research findings emphasize the importance of giving priority to the development of information literacy and digital literacy skills for pre-service teachers in the field of education. This is because these skills are strongly correlated with higher levels of ICT self-efficacy. The study also underscores the necessity for teacher training and professional development programs that specifically target the enhancement of information literacy and digital literacy. By focusing on these literacies, such programs have the potential to improve preservice teachers' ICT self-efficacy in teaching and enhance the effective utilization of ICT in educational settings.

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
56	1	10

مقاله پژوهشی

بررسی نقش سواد اطلاعاتی، سواد دیجیتال و خودکارآمدی ICT دانشجومعلمان در تدریس

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چکیده

پیشینه و اهداف: در قرن بیست و یکم، فناوری نقش مهمی در تنظیم سبک زندگی جامعه دارد. بهدلیل پیشرفت سریع فناوری در رایانه، اینترنت و تلفن های هوشمند، زندگی مردم تحت سلطه یک محیط اطلاعاتی است. فناوری اطلاعات و ارتباطات شاخه خاصی از فناوری اطلاعات است که دسترسی به اطلاعات را تسهیل می کند. فناوری اطلاعات و ارتباطات می تواند به بهبود تجارب تدریس معلمان و آماده سازی آن ها برای خواسته های قرن ۲۱ کمک کند. به منظور اثربخشی در استفاده از فناوری اطلاعات و ارتباطات، معلمان ملزم به داشتن مهارت های آموزشی خودکارآمدی کافی هستند. خودکارآمدی فناوری اطلاعات و ارتباطات مفهومی است که فرد باور دارد که توانایی استفاده از فناوری اطلاعات و ارتباطات را برای وظایف خاص دارد. مهارت‌های سواد اطلاعاتی و سواد دیجیتالی برای اینکه معلمان توانایی خود را در استفاده از فناوری اطلاعات و ارتباطات توسعه دهند، مورد نیاز است. با این ملاحظات، در این پژوهش رابطه بین سواد اطلاعاتی و سواد دیجیتالی معلمان پیش از خدمت و توانایی آنها در استفاده از فناوری اطلاعات و ارتباطات برای اهداف یادگیری بررسی شده است.

روش‌ها: این پژوهش از طرح تحقیق پیمایشی، جمع‌آوری داده‌ها از طریق پرسشنامه آنلاین و تحلیل داده‌ها از طریق تحلیل عاملی تأییدی بهره برده است. برای جمع‌آوری داده‌ها، یک نظرسنجی آنلاین مشتمل بر دو پرسشنامه، در بین دانشجومعلمان دانشگاه فرهنگیان زنجان در سال ۱۴۰۲ انجام شد. یکی از پرسشنامه‌ها توسط پینتو و مارکاوسکایت تدوین گردیده و روایی و پایایی آن تایید شد، در حالی که پرسشنامه دوم از چارچوب مرجع جهانی مهارت های سواد دیجیتال گرفته شده است. شرکت کنندگان از میان گروه های مورد مطالعه با شیوه نمونه‌گیری خوشه‌ای طبقه‌ای گزیده شدند و از مجموع ۱۷۰۰ دانشجومعلم در دو پردیس دانشگاه فرهنگیان زنجان (الزهرا و شهید بهشتی)، ۳۱۳ دانشجومعلم به عنوان نمونه انتخاب شدند که طبق جدول مورگان کفایت لازم برای نمایندگی جامعه مذکور را دارد. داده های نظرسنجی با استفاده از تحلیل عاملی تاییدی (CFA) برای بررسی رابطه بین متغیرهای نهفته تجزیه و تحلیل شد. برای ارزیابی چارچوب پیشنهادی از مدل سازی معادلات ساختاری (SEM) نیز استفاده شده است.

یافته‌ها: نتایج تحلیل CFA و SEM نشان داد که ادراک دانشجومعلمان از سواد اطلاعاتی، تأثیر مستقیم و مثبتی بر درک آنها از سواد دیجیتال دارد. همچنین یافته ها نشان داد که سواد اطلاعاتی دانشجومعلمان تأثیر مستقیم و مثبتی بر اعتماد به نفس آن ها در استفاده از فناوری اطلاعات و ارتباطات برای تدریس دارد (خودکارآمدی). علاوه بر این، این مطالعه نشان داد که سواد دیجیتال ادراک شده دانشجومعلمان نیز تأثیر مستقیم و مثبتی بر اعتماد به نفس آن ها در بهره‌گیری از فناوری اطلاعات و ارتباطات برای تدریس دارد. با این حال، در مقایسه با سواد دیجیتال ادراک شده، سواد اطلاعاتی ادراک شده تأثیر قوی تری بر خودکارآمدی ICT دانشجومعلمان در هنگام تدریس دارد.

نتیجه‌گیری: نتایج این مطالعه اهمیت اولویت‌دهی دانشجومعلمان به توسعه مهارت‌های سواد اطلاعاتی و همچنین مهارت‌های سواد دیجیتال را نشان می‌دهد، زیرا ارتباط تنگاتنگی با خودکارآمدی بالاتر در فناوری اطلاعات و ارتباطات در میان دانشجو معلمان در حین تدریس دارند. . همچنین نیاز به آموزش معلمان و برنامه‌های توسعه حرفه‌ای با تمرکز بر افزایش سواد اطلاعاتی و سواد دیجیتال را متذکر می‌گردد؛ زیرا این سوادها پتانسیل بهبود خودکارآمدی ICT دانشجومعلمان را در تدریس و استفاده بیشتر از فناوری اطلاعات و ارتباطات در محیط‌های آموزشی دارند.

Introduction

There has been a significant increase in the advancement of information and communication technology (ICT), which has had a profound impact on various fields, including education [1]. In the educational context, teachers play a crucial role in implementing and integrating ICT into their teaching practices, as they possess expertise in delivering educational content [1-2]. The effective integration of ICT in education heavily relies on the preparation of

individual teachers to utilize technological tools [3]. The self-efficacy of teachers in using ICT forms the foundation for their comfort and confidence in utilizing technology in the classroom.

It is suggested that an individual's feelings and beliefs about their own thoughts and actions are the basis for self-efficacy. These beliefs on self-efficacy also play a major role in the development of an individual's mind, emotions, and motivation. Teachers 'efficacy is based on their belief and trust that they can teach effectively in the classroom [5]. Individuals' self-efficacy is influenced by specific activities. With regard to teachers' teaching practices with ICT, Krumsvik [6] underlines the importance of taking into account their ability to act independently. Hatlevik and Hatlevik [7] distinguish between general ICT self-efficacy and ICT self-efficacy for educational purposes. ICT self-efficacy is strongly linked to teacher motivation in carrying out the mission of education [8], their level of job satisfaction [9], the creation of innovative learning designs, and the active involvement of students [10]. Furthermore, it plays a role in enhancing overall well-being [11-10].

Related to the concept of ICT, digital literacy has emerged as a significant issue for those within the education sector, encompassing students, educators, and policymakers. Therefore, to enhance the effectiveness of education in this digital age and aid in achieving set objectives, English teachers should possess advanced digital skills. In addition, the concept of digital literacy is inextricably related to a further significant field: Information Literacy which requires individuals to access and use current information.

In general, there has been a lack of research on teacher ICT self-efficacy with regard to information and digital literacy. The dearth of research in this area certainly gives rise to sufficient grounds for an investigation into the relationship of Iranian EFL teachers with respect to their level of ICT self-efficacy and Digital and Information Literacy. This paper therefore aims to provide novel insight into this area by studying the relationship between perception of information and digital literacy, as well as teachers' perceptions of ICT self-efficacy for teaching goals. The primary aim of the research is to investigate the impact of perceived information and digital literacy on preservice teachers ICT self efficacy in teaching context. For this purpose, the following research questions have been proposed:

o Does information literacy have an impact on the ability of preservice teachers to use ICT effectively?

o Does digital literacy have an impact on the ability of on the ability of preservice teachers to use ICT effectively?

o How does preservice teachers' information literacy relate to their digital literacy?

Review of the Related Literature

Information literacy

At first, research into information literacy primarily took place in the field of library studies. However, there has been a growing emphasis on education research in both higher education and school settings [12-16]. Individuals with information literacy have been defined as those who can obtain and evaluate information to meet their information needs [17]. Changes in the curriculum of Higher Education and Teacher Training are required by the evolution of information resources [18]-[19]. In 2000, the Association of Colleges and Research Libraries announced that information literacy includes a set of skills whereby individuals can recognize their need for information, learn how to find it, assess its value, and use it efficiently. In a 'new curriculum

for information literacy' [20], student learning in the digital era depends on their possession of information literacy as a collection of skills, attributes, and behaviors. La [21] included library skills and computer literacy as essential components of Information Literacy.

The lack of information literacy skills could lead to difficulties in adapting to the ever-changing world of information technology. Shannon et al. [22] claimed that teachers are often deficient in information literacy skills and highlighted examples where they were not well acquainted with the concept of information literacy or did not understand it within their teaching curriculum. Furthermore, they noticed that information literacy courses are not being taught in all teacher training programs. These results are in line with previous studies, which showed that students have not developed the necessary information literacy skills [23].

A set of digital skills that include operational, formal, information, communications, content creation, and strategic skills have been presented by Van Dijk and Van Deursen [24]. They point out the absence of a focus on information literacy skills. Information literacy includes a variety of skills and competencies [25], e.g., the ability to consider the quality and relevance of information relating to search targets, evaluating the reliability and value of information as well as taking advantage of new information for professional practice and planning purposes.

Information Literacy is a fusion between library literacy, computer and media literacy, as well as digital literacy [26]. Acquiring these literacies empowers information users to become self-reliant lifelong learners. Information literacy enables people to distinguish between information needed and the particular kinds of information they need. It provides information resource users with strategies to navigate the vast amount of information available from different sources.

While in the past, it has been thought that people could access information without ICT literacy, today's IT-driven society is intimately linked to Information Literacy [27]. Teachers need to be able to effectively search and find information through digital means in the 21st-century knowledge age so that they can pass it on to future generations. It is not known what level of information literacy the teachers possess and whether they are willing to take part in an information search. Lack of confidence and ability to search for information in their profession, which has always been a concern, was reported by Best et al. [28]. Consequently, it is possible to assume that preservice teachers need information literacy skills for effective use of information resources and ICT.

ICT self-efficacy in teaching

According to Bandura's social cognitive theory of behavior change, self-efficacy is defined as "individuals' beliefs in their ability to achieve desired levels of performance and exert influence over events that impact their lives" [4, p. 82]. In many instances, self-efficacy may be specific to one context or domain and Bandura's theory suggests that it is in many cases more appropriate to look at the individual domains of self-efficacy.

The self-efficacy of teachers is about their personal belief that they are capable of planning and achieving educational objectives [29]. The level of self-efficacy among teachers determines their belief in their ability to influence student learning and behavior. It should be noted that self-efficacy is not about the different skills a teacher has, but rather his or her belief as to what he or she will achieve with these skills in an individual situation [4] and how they can successfully perform their

tasks [30]. Research has demonstrated that teachers' belief in their own capabilities, referred to as self-efficacy, has multiple positive effects. Firstly, it enhances their motivation [8]. Secondly, it facilitates the development of innovative instructional design [29]. Lastly, it fosters a positive and responsive classroom environment [31]. Due to these benefits, self-efficacy is considered crucial for teachers' actual teaching practice [3].

A correlation of self-efficacy with education outcomes was underlined by several research findings [10], and Recent studies that showed that a teacher's self-efficacy and educational quality are related have contributed to this area of research [32]. The positive correlation between teachers' self-efficacy to use technology and integrating ICT into their teaching practices has been observed [3]. Nonetheless, the frequency of ICT usage is a crucial factor, as infrequent use of ICT is linked to lower levels of ICT self-efficacy [33].

Teachers' self-efficacy is also important in determining the effort level they invest in areas such as information and digital literacy, as well as their resilience when faced with challenges and difficulties in utilizing or adjusting ICT for teaching goals. Therefore, teachers' success in incorporating ICT into their teaching is influenced by various factors, with information literacy and digital literacy being particularly significant [29]. While teacher training in ICT can positively impact the use of computers by teachers, improving their own self-efficacy, it is worth noting that there may not always be a direct correlation between proficiency in ICT and higher self-efficacy [34].

Digital Literacy

To mitigate the significant impact of technological advancements on teachers' careers, teachers need to possess and continuously improve their competencies. While accessing and using digital platforms appear intuitive, effective utilization requires digital literacy [35]. Digitally literate individuals inevitably develop technology skills. For individuals, digital literacy training gives them the ability to use computers, software applications, databases and more technology in pursuit of their individual, professional, or educational goals.

The emergence of new developments and technologies has brought about changes in communication, learning, information creation, work, and governance for individuals, groups, and societies [36]. It is also essential that individuals have not only the capacity and skills to use technology tools but also knowledge of adequate standards and practices within this new societal reality [37]. Understanding when information is required, where to find it, and how to use it effectively are crucial for digital literacy in the 21st century [38]. Teachers must be equipped with knowledge that can effectively satisfy the technological and informational needs of a generation that will shape information society in the 21st century [39]. Integration of technology is crucial for teachers to cope with rapid technological developments that affect teaching environments [40].

It is argued that digital literacy skills, including various technical skills, are also acquired by individuals with information literacy skills [41]. Digital literacy encompasses information literacy skills such as locating and utilizing necessary information, as well as communication, collaboration, digital social awareness, e-security awareness, and information creation [42]. Today's digital environment provides teachers with an exclusive opportunity to access information, tools, and resources for teaching and learning. Teachers must therefore possess the

knowledge and skills in information and digital literacy. In the 21st century, it has become an essential skill and a requirement to gather information using digital tools and to present it in a way that supports students' learning at their own level, while also becoming content creators with the necessary digital skills. It is necessary to have information and digital literacy skills for teachers who play an important role in shaping future generations. Accordingly, the following hypotheses are postulated:

(H1) The digital literacy of the preservice teachers is directly affected by perceived information literacy.

(H2) Preservice teachers' ICT self-efficacy in teaching is directly affected by perceived information literacy.

(H3) Preservice teachers' ICT self-efficacy in teaching is directly affected by perceived digital literacy.

Method

Participants

The participants in this study were pre-service teachers from Farhangian University in Zanjan Province, Iran. A student who enrolled in a teacher training program is considered to be the pre-service teacher. Farhangian University is a public institution dedicated to teacher training, consisting of over 90 teacher-training colleges and enrolling more than 39,000 students. It plays a significant role in preparing pre-service teachers across various disciplines in Iran.

A total of 310 students took part in the research, with 200 students (64.5%) from Alzahra University and 110 students (35.5%) from Shahid Beheshti University. Both universities offer undergraduate programs for individuals aspiring to become preschool and elementary school teachers, subject teachers,

and special educators across all grade levels. Additionally, the universities provide professional development and improvement courses for practicing teachers.

The stratified cluster sampling method was used to guarantee the representativeness of the study sample. This method divided the primary sample of two Farhangian universities into study groups and assigned different majors a list of all university study groups. A random sample of study groups was selected from each major, and all students in each selected study group participated in the study. The 5% confidence interval and 95% confidence level have been used for calculating the reliability of the sample.

According to the Farhangian University of Zanjan, there were 1701 students enrolled in teacher training programs in 2022 in Zanjan, Iran. The researchers were able to determine the relevant sample size of their study using a Krejcie and Morgan table, without having to examine every single person in the population. Based on the Krejcie and Morgan Table, if the population consists of 1700 people, the table can be referenced to determine that the researcher only needs feedback from 313 individuals. This facilitates the conduct of a quantitative study for the research. The selected sample of 310 students was therefore considered to be representative.

Instruments

Online questionnaires were prepared and made accessible for participants to complete. From September to October 2022, students were invited to the study, which was conducted using an online survey. Participation was voluntary because of the online implementation of the survey.

In this study, a survey was carried out to assess the level of ICT self-efficacy in teaching, as well as the perception of information literacy and digital literacy of preservice teachers. The

survey consisted of two questionnaires, one of which had been rigorously created by Markauskaite et al. [43] and Pinto [11] respectively, and the other was taken from the Global Framework of Reference on Digital Literacy Skills [44].

Markaiteuska and al. [43] have developed an ICT literacy assessment section for measuring the self-efficacy of preservice teachers in using information and communication technologies to teach. The intention to use ICT in future work is addressed in this section, which includes six components related to the belief in the use of ICT in teaching careers. In this study, only one element, the perception that ICT is used for enhancing education and learning has been analyzed. This component was used to create a latent variable (ICT-S), which is represented by seven observed variables. The latent factor is identified as the unobserved variable, ICT-S.

Pinto's certified tool for IT literacy, the simple version of information literacy and humanities and social science (IL-HUMASS) which is available online was also used. The use of this instrument was to explore the opinion of preservice teachers about the phenomenon of information literacy. In addition, the Global Framework of Reference on Digital Literacy Skills [44] was used to analyze perceived digital literacy (DL) (Table 2). The measured latent factor (IL) consists of eight observed variables, while the measured latent factor (DL) consists of five observed variables (Table 2).

The convergent validity of three latent variables was assessed: ICT-S, IL, and DL. For the ICT-S variable, we used the average variance extracted (AVE) and composite reliability (CR) measures, which showed that AVE = 0.614 (> 0.50) and CR = 0.899 (> 0.70), indicating appropriate convergent validity and composite reliability. Similarly, for the IL variable, the AVE and CR values were AVE = 0.605 (> 0.50) and CR

= 0.912 (> 0.70), respectively, suggesting satisfactory convergent validity [45].

Therefore, the convergent validity and composite reliability are deemed suitable. Lastly, we evaluated the convergent validity of the latent variable IL-E using the AVE and CR measures, which yielded AVE = 0.693 (> 0.50) and CR = 0.749 (> 0.70). This indicates that the convergent validity and composite reliability of IL are also appropriate.

To assess the internal consistency of the latent variable ICT-S, Cronbach's alpha was employed. The findings affirmed that the items within the variable are strongly interrelated as a collective. Specifically, the Cronbach's alpha value for ICT-S was 0.883 (> 0.65), indicating high internal consistency. Additionally, the normality of the ICT-S dataset was examined by analyzing the skewness and excess kurtosis. The absolute values of both skewness and kurtosis, which should be less than 2 for normality, were evaluated (Table 3).

To assess the internal consistency of the latent variable IL, we employed Cronbach's alpha. The findings indicated a strong interrelationship among the IL items as a whole. Specifically, the Cronbach's alpha value for IL was 0.877 (> 0.65), suggesting high internal consistency. Additionally, we examined whether the IL dataset followed a normal distribution. The absolute values of skewness and kurtosis were evaluated, and they indicated the normality of the IL dataset (absolute values were less than 2; Table 4).

The fitness of the latent variable (DL) items revealed sufficient fit and confirmed six questionnaire blocks. The internal reliability of this question group was confirmed by Cronbach's alpha values of 0,877 to 0.650. Then, the normality of the (DL) data was checked. The absolute values for skewness and kurtosis indicate the normality of the (DL) data set (absolute values are less than 2; Table 5).
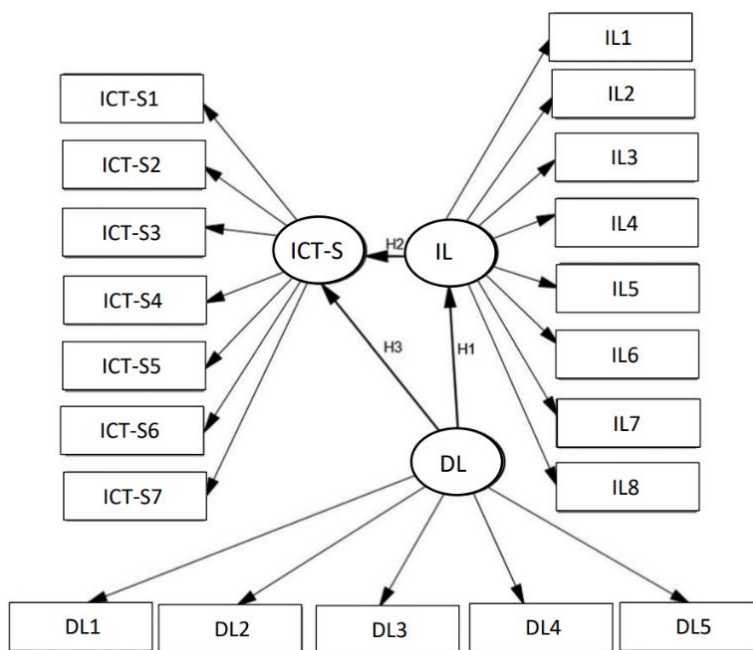
Fig. 1: The conceptual model of the relationship between variables: ICT-S, IL, and DL

Table 1: The internal content of the variable latent: ICT self-efficacy in teaching, (ICT-S)

Code	Items: I think I will
$ICT-S_1$	Find ways to enhance classroom teaching by incorporating ICT activities
$ICT-S_2$	Integrate ICT into my standard classroom curriculum
$ICT-S_3$	Use various methods of delivering new information
$ICT-S_4$	Create assignments that require students to submit work that has been created using ICT
$ICT-S_5$	Develop assignments that require students to utilize ICT tools for presentations
$ICT-S_6$	My students will utilize different software tools for mind mapping and brainstorming
$ICT-S_7$	Develop lesson plans that focus on teaching students ICT skills within specific subjects

Table 2: Latent variables in the perception of information literacy: information literacy (IL) and digital literacy (DL)

The latent variable	Observed variable codes	The observed variable
Information literacy (IL)	IL_1	To use physical sources of information including books and papers for this purpose
	IL_2	To access and use automated catalogs
	IL_3	To refer to and utilize the main information sources electronically
	IL_4	To utilize secondary sources of information through electronic means
	IL_5	To familiarize oneself with terms that apply to the subject
	IL_6	To search the Internet to find and access information
	IL_7	To use informally accessible digital sources of information
	IL_8	To understand tactics for searching for information
Digital literacy (DL)	DL_1	To know what digital content is necessary for the operation of software technologies
	DL_2	To assess, compare, and critically evaluate the credibility and reliability of digital content sources
	DL_3	To explore and locate data, information, and content within digital environments
	DL_4	To share data, information, and digital content with others
	DL_5	To utilize digital tools and technologies to facilitate cooperation

Table 3: ICT-S data set normality: pre-service teachers' self-efficacy in enhancing teaching and learning with ICT

	ICT-S1	ICT-S2	ICT-S3	ICT-S4	ICT-S5	ICT-S6	ICT-S7
Skewness	-1.026	-1.228	-1.760	-0.918	-0.858	-1.037	-1.037
S.E	0.153	0.153	0.153	0.153	0.153	0.153	0.153
Kurtosis	0.859	1.978	1.884	0.595	0.487	1.160	1.254
S.E	0.305	0.305	0.305	0.305	0.305	0.305	0.305

Table 4: Normality of (IL) model data: pre-service teachers' perceived information literacy

	IL1	IL2	IL3	IL4	IL5	IL6	IL7	IL8
Skewness	-1.910	-0.895	-1.230	-1.038	-0.610	-1.012	-0.716	0.050
S.E	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153
Kurtosis	1.315	0.311	1.231	0.689	0.560	0.464	-0.415	-0.421
S.E	0.305	0.305	0.305	0.305	0.305	0.305	0.305	0.305

Table 5: Pre-service teachers perceived digital literacy (DL): normality of data

	DL1	DL2	DL3	DL4	DL5
Skewness	-0.609	-0.970	-0.609	-0.799	-0.598
S.E	0.153	0.153	0.153	0.153	0.153
Kurtosis	0.326	2.047	0.105	0.595	0.599
S.E	0.305	0.305	0.305	0.305	0.305

Results and Findings

To examine two hypotheses (H1 and H2), we utilized the robust SEM software Amos for structural equation modeling (SEM). This approach allowed us to explore the relationships among the latent variables (ICT-ST, IL, and DL). SEM consists of two components: a measurement model, which is essentially CFA, and a structural model.

A CFA was conducted to examine the internal structure of the latent variables: pre-service teachers' self-confidence in teaching (ICT-S), perceived information literacy (IL), and perceived digital literacy (DL).

A CFA was conducted to examine the ICT self-efficacy in teaching (ICT-S) latent variable. Unstandardized coefficients (β) for both the observed variables and the latent factor (ICT-S) were calculated and are presented in Table 7. The unstandardized beta value indicates the impact of the predictor (observed) variable on the dependent (latent) variable.

The standardized beta (β) is comparable to a correlation coefficient. The self-efficacy of pre-service teachers in teaching with ICT is most strongly associated with 'Develop assignments that require students to utilize ICT tools for presentations '(β = 0.765; Table 7). The results of the CFA indicate that the relationship between the predictor (observed) variables and the dependent (latent) variable (ICT-S) was statistically significant for all cases (Table 7).

The CFA results provide the coefficient of determination (R^2) for each aspect, indicating the percentage of variation in the ICT-S model explained by the observed variables. The coefficient of determination (R^2) for the variable teachers' ICT-S ranged from 42.7% to 58.4% (Table 4). This implies that 42.7% to 58.4% of the data align with the regression model.

A CFA was performed on the latent variable 'perceived information literacy' (IL) (Tables 8, 9). The CFA results indicated a statistically significant relationship between the latent variable (IL) and all variables of perceived information literacy (Table 8). The highest unstandardized beta values were observed for information strategies (B = 1.729) and searching for and retrieving internet information (B = 1.612), while the lowest value was for utilizing electronic sources of primary information (B = 0.843; Table 8). The coefficient of determination (R2) suggests that the data closely align with the regression lines, as the absolute values of R2 exceed 0.20 (Table 8).

A CFA of the respondents' perceived digital literacy according to the Global Framework of Reference on Digital Literacy Skills was performed. Standardized and unstandardized coefficients for the observed variables and the latent variable (DL) were deducted (Table 9).

The results of the CFA showed that pre-service teachers' belief in their ability to search for data in digital environments was strongly linked to their perceived digital literacy. The coefficient of determination for the latent variable (IL) was high, indicating that pre-service teachers were skilled in analyzing, comparing, and evaluating the credibility and reliability of digital sources, as well as exploring data, information, and content in digital environments.

The results of CFA revealed that the relation of the predictor (observed) variables to the dependent (latent) variable (IL) was statistically significant in all cases (Table 9).

As mentioned earlier, SEM, in comparison with CFA, extends the possibility of relationships among the latent variables. We analyzed the relationship between perceived information literacy and perceived digital literacy (H_1), the relationship between perceived information literacy and ICT self-efficacy in teaching (H_2), and the relationship between perceived digital literacy and ICT self-efficacy in teaching (H_3).

The findings of SEM (*p* values) revealed that pre-service teachers' perceived information literacy directly and positively affects perceived digital literacy (*B* = 0.988), (R^2 = 0.543, *p* < 0.01). The findings showed that perceived information literacy directly and positively affects the ICT self-efficacy in the teaching of pre-service teachers (*B* = 0.555), (R^2 = 0.660, *p* < 0.01). It also revealed that perceived digital literacy directly and positively affects ICT self-efficacy in teaching (*B* = 0.357), (R^2 = 0.660, *p* < 0.01).

The greatest R^2 values involve H2 and H_3 (Table 10). This means that 66.2% of preservice teachers' ICT self-efficacy in teaching is influenced by perceived information and digital literacy. The remaining 33.8% is influenced by other factors.

Table 6: Fitness of items for the latent variables: Model ICT-S, IL, DL, and final model

Model	Absolute fit index		Relative fit index				
		χ^2/df	RMSEA	GFI	IFI	TLI	CFI
ICT-S	Assumed model	2.015	0.059	0.970	0.996	0.968	0.997
IL	Assumed model	2.101	0.065	0.987	0.981	0.960	0.992
DL	Assumed model	1.281	0.043	0.992	0.999	0.989	0.999
Structural model	Assumed model	2.305	0.074	0.875	0.941	0.927	0.935
	Acceptance value	1–5	< 0.08	> 0.80	> 0.90	> 0.90	> 0.90

Table 7: Standardized and unstandardized coefficients for the latent variables of ICT self-efficacy in teaching

Code of observed variable	Observed variable	R^2	B	S.E	β	p
ICT-S_1	Find ways to enhance classroom teaching by incorporating ICT activities	0.525	0.841	0.076	0.728	<.001
ICT-S_2	Integrate ICT into my standard classroom curriculum	0.522	0.765	0.072	0.725	<.001
ICT-S_3	Use various methods of delivering new information	0.425	0.674	0.066	0.655	<.001
ICT-S_4	Create assignments that require students to submit work that has been created using ICT	0.501	0.951	0.086	0.716	<.001
ICT-S_5	Develop assignments that require students to utilize ICT tools for presentations	0.574	1.052	0.092	0.763	<.001
ICT-S_6	My students will utilize different software tools for mind mapping and brainstorming	0.499	0.881	0.083	0.695	<.001
ICT-S_7	Develop lesson plans that focus on teaching students ICT skills within specific subjects	0.569	1.010		0.759	

Table 8: Standardized and unstandardized coefficients for the latent variables of pre-service teachers' perceived information literacy (IL)

Code of observed variable	Observed variable	R^2	B	S.E	β	p
IL_1	To use physical sources of information including books and papers for this purpose	0.280	1.002		0.525	<.001
IL_2	To access and use automated catalogs	0.295	0.937	0.089	0.534	<.001
IL_3	To refer to and utilize the main information sources electronically	0.250	0.843	0.121	0.512	<.001
IL_4	To utilize secondary sources of information through electronic means	0.542	1.586	0.221	0.753	<.001
IL_5	To familiarize oneself with terms that apply to the subject	0.563	1.569	0.213	0.789	<.001
IL_6	To search the Internet to find and access information	0.616	1.612	0.213	0.789	<.001
IL_7	To use informally accessible digital sources of information	0.357	1.261	0.188	0.597	<.001
IL_8	To understand tactics for searching for information	0.563	1.729	0.237	0.763	<.001

Table 9: Standardized and unstandardized coefficients for the latent variables of pre-service teachers' perceived digital literacy (DL)

Code of observed variable	Observed variable	R^2	B	S.E	β	p
DL1	To know what digital content is necessary for the operation of software technologies	0.274	0.791	0.118	0.531	<.001
DL2	To assess, compare, and critically evaluate the credibility and reliability of digital content sources	0.730	1.446	0.194	0.849	<.001
DL3	To explore and locate data, information, and content within digital environments	0.772	1.460	0.197	0.881	<.001
DL4	To share data, information, and digital content with others	0.115	0.812	0.160	0.315	<.001
DL5	To utilize digital tools and technologies to facilitate cooperation	0.243	1.001		0.485	

Table 10: Standardized and unstandardized coefficients of structural model: ICT self-efficacy in teaching; information literacy; digital literacy

Hypothesis	Path analysis	Effect	R^2	B	S.E	β	*p*
H$_1$ confirmed	DL→IL	Direct	0.543	0.988	0.111	0.741	<.001
H$_2$ confirmed	IL→ICT-S	Direct	0.660	0.555	0.098	0.579	<.001
H3 confirmed	DL→ICT-S	Direct	0.660	0.357	0.121	0.291	<.001

Discussion

The research examined the impact of perceived information and digital literacy on the preservice teacher's self-efficacy in the use of ICT for teaching. The results of the hypotheses in the research align with findings from other authors. General ICT self-efficacy has been found to predict strategies for the evaluation of information literacy [3].

Several studies have explored the concept of information literacy and self-efficacy, with Yan et al. [46] emphasizing its importance in dealing with information overload. In a world with an abundance of information, information literacy helps us determine what information is necessary, when and where to find it, and how to effectively utilize it [47]. In their analysis of the connection between self-efficacy and information literacy among online learners, Tang and Tseng [48] found that self-efficacy for information searching is positively associated with self-efficacy for online learning. Additionally, the positive association between self-efficacy in online education and information manipulation can be seen.

The findings of this study are also consistent with those of Pınar Kahveci [49], who found a strong positive correlation between digital literacy and teachers' self-efficacy. Another study by Maria Ulfatul Jamila et al. [50] suggested that digital literacy affects behavioral intention with ICT self-efficacy. Overall, the results suggest that ICT self-efficacy is positively

affected by digital literacy enabling technology to be used more effectively in a variety of contexts.

Several studies have also established a positive correlation between information literacy and digital literacy. One of the findings in a study conducted by Seda Guduzalp [51], is that teachers' knowledge of information literacy impacts positively on their digital literacy skills. In another study by Rosanne Marie Cordell [52], information literacy and digital literacy are not considered opposing concepts; instead, they are interconnected and crucial for students pursuing higher education. Digital literacy, which involves understanding and using information in various formats from numerous sources, especially those presented via computers, provides the fundamental skills required for managing digital environments.

The findings from hypothesis testing align with the results of previous researchers [7]-[9]-[6]-[53] who have indicated that the ICT self-efficacy of teachers plays a crucial role in their ability to incorporate ICT into their teaching practice. These studies have also found that higher levels of ICT self-efficacy are correlated with greater confidence in using ICT for teaching purposes. Additionally, Hammond et al. [33] discovered that teachers with lower ICT self-efficacy tend to use ICT less frequently.

The theoretical innovation of this study lies in its comprehensive examination of the research subject and the identification of clear connections between information and digital literacy and ICT self-efficacy.

Conclusions

The study's SEM results have provided updated insights into the relationships between digital literacy and ICT self-efficacy, as well as the relationships between information-searching literacy and ICT self-efficacy among preservice teachers.

The SEM findings (Table 10) highlight the practical implications for the design of information literacy programs for preservice teachers, both in terms of instructional organization and teaching principles. When creating curricula for information literacy, it is crucial to allocate sufficient time for program implementation. Based on the SEM results, it is recommended to prioritize the development of information literacy over digital literacy for preservice teachers, as information literacy has a stronger direct impact on their ICT self-efficacy (Table 10). Therefore, an integrated approach should be adopted when designing the content of information literacy and digital literacy programs for preservice teachers, encompassing both theoretical instruction and practical tasks.

Program developers should take into account the ever-evolving nature of ICT used in educational practice [1]-[2]. Insufficient knowledge about new ICT can diminish teachers' ICT self-efficacy [54]. However, as mentioned earlier, the adoption of new ICT in educational practice relies on teachers' ICT self-efficacy [7]-[9]-[6]-[53]. The SEM results demonstrate that information and digital literacy play a crucial role in determining teachers' ICT self-efficacy (Table 10). Therefore, both preservice and in-service teacher training programs should prioritize the development of information and digital literacy to enhance teachers' ICT self-efficacy, as it is closely linked to ICT integration in schools.

Authors' Contribution

A. Ramazani has made contributions to the theoretical background and the drafting and revising of the introduction, methodology, and discussion sections. Z. Talebi has contributed to collecting, analyzing, and interpreting the results. The final version of the paper was examined and endorsed by all authors.

Conflicts of Interest

The authors have no conflicts of interest.

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