THE EFFECT OF PRESERVICE TEACHERS' INFORMATION AND COMMUNICATION TECHNOLOGIES COMPETENCIES ON ACADEMIC SELF-EFFICACY AND ACADEMIC ACHIEVEMENT

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***Abstract.** The purpose of this study was to measure the ICT competency levels and academic self-efficacy perception levels of preservice teachers and to determine if those levels were a significant predictor of their academic self-efficacy. For this purpose, the data were obtained from 411 volunteer students studying in the second, third, and fourth grades of the Teacher Training Undergraduate Programs at Erzincan Binali Yıldırım University Education Faculty. In total, 133 male and 278 female students participated in the study. As data collection tools, the Personal Information Form, the Information and Communication Technology Competencies Scale for Pre-service Teachers (ICTC-PT) developed by Tondeur et al. (2017) and adapted to Turkish language and culture by Alkan and Sarıkaya (2018) as well as the Academic Self-Efficacy Scale (ASES) developed by Kandemir (2010) were used. The Personal Information Form included information regarding department,*

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grade, gender, and GPA. The reliability analyses of the scales were carried out, as well as multiple and stepwise regression analyses and descriptive statistics to address the research questions. As a result, it was determined that pre-service teachers' perception of ICT self-efficacy was at a high level. A moderate level of perception was observed in the sub-dimensions of ASE-CAP, ASE-AE, and ASE-APL among the participants. ICT-ID was found to be a significant predictor of ASE-CAP, but not of CSP-ICT. Although CSP-ICT was more closely related to general competencies, ICT-ID appeared to be more closely related to the skills required by the teaching profession. Based on the results of the study, the ASE-CAP, ASE-APL, and ICT sub-dimension scores were not significant predictors of GPA, whereas the ASE-AE score was a significant and positive predictor of GPA. It could be concluded from these findings that experiences and activities aimed at improving students' self-efficacy perceptions contributed positively to academic achievement in teacher training programs.

Keywords: *Teacher training; information and communication technology competencies; academic self-efficacy; academic achievement.*

1. INTRODUCTION

Text The concept of digital citizenship is very broad in scope. According to Ribble and Bailey (2007), digital citizenship refers to appropriate and responsible behavior in relation to the use of technology, and they define digital citizens under nine different headings. Today, being a digital citizen has become even more important and this has implications for the teaching process (İşman and Güngören, 2014). As part of this process, digital citizenship concerns teachers who can view it as a technology problem rather than a social issue that affects all of society. Digital literacy is one of the most important dimensions of digital citizenship (Ribble, 2012). Digital literacy entails the ability to find the right information, to produce, share, and use technology in the teaching process coupled with the ability to correctly use different types of technology (Hamutoğlu et al., 2017). The concept of digital literacy exists in a variety of expressions in accordance with the advancement of technology (Buckingham, 2015). A number of literacy types are included in digital literacy, including information literacy, computer literacy, and information and communication technology literacy (Tor, Başaran, and Arık, 2022).

In the teaching profession, access to information is an essential requirement. Information and communication technology (ICT) offers effective and accessible opportunities to meet this need quickly and effectively. Throughout the world, information and communication technology (ICT) has emerged as a catalyst for development (İslam, Karia, Khaleel et al., 2019). It is true that ICTs are easily accessible in environments where necessary tools and infrastructure are available, but using these technologies requires the beneficiaries to possess a certain level of knowledge and competence. Similarly, to many other professions, these competencies are equally important during the preparation process for teaching and during the course of the teaching career. The availability of access to up-to-date information resources in a timely and efficient manner is essential for teachers. The use of information and communication technologies is also expected to contribute to the success of students (Alkan and Sarıkaya, 2018). It is generally believed that ICTs can contribute significantly to learning and achievement for teachers and

students (Meenashki, 2013). In spite of the fact that ICT has been identified as a tool for increasing academic performance in the past, recent studies discuss the negative consequences of ICT addiction for students (İslam, Karia, Khaleel et al., 2019).

One of the key concepts in Bandura's Social-Cognitive Theory is self-efficacy. The term self-efficacy refers to a person's belief in their ability to achieve a certain goal (Bandura, 1977, p.167). A person's perception of self-efficacy regarding certain behaviors affects their ability to perform those behaviors successfully (Ekici, 2008). As for the perception of academic self-efficacy, it is the feeling that one is capable of completing academic tasks with success (Yılmaz, Gürçay & Ekici, 2007). A large number of studies have demonstrated the importance of high academic self-efficacy for students (Yılmaz, Gürçay, and Ekici, 2007; Ekici, 2008; Kandemir, 2010).

As an essential component of a productive competence system, efficiency beliefs play a crucial role. This is why different individuals with similar skills or the same individual under different conditions may perform inadequately, adequately, or exceptionally depending on their personal efficacy beliefs (Bandura, 1997, p.37). Besides personal experiences and indirect experiences, verbal persuasion as well as psychological and emotional states also contribute to self-efficacy perceptions (Bandura, 1977). Likewise, information and communication technology (ICT) competencies are also based on personal experiences and, in this context, are related to self-efficacy perceptions. The level of self-efficacy is believed to affect course success (Öncü, 2012). This viewpoint is supported by some research findings (Zimmerman, 1995, Hampton and Mason, 2003; Alçı, Erden, and Baykal, 2008; Azar, 2010; Yenilmez and Kakmacı, 2008; Honicke and Broadbent, 2016; Bahar, 2019).

The use of Information and Communication Technologies (ICT) for educational purposes not only affects the quality of manpower such as instructors and students but also affects the quality of the physical environment and equipment used in education (Yılmaz, Başat, and Özer, 2020). It can be argued that in the teacher training undergraduate programs (Council of Higher Education, CoHE, 2018), which have been implemented since 2018, "information technologies" and "instructional technologies" courses can contribute to improving the ICT competencies of preservice teachers as part of the preparation process.

Due to the significant impact that one of the focal variables of the teaching process has on academic achievement, it is essential to investigate the factors that affect the perception of academic self-efficacy. It is considered critical to conduct this study to determine both the ICT competency levels of preservice teachers as well as their academic self-efficacy. Additionally, the study is important for identifying whether ICT competency is a significant predictor of academic achievement and academic self-efficacy. Assessing both ICT and academic self-efficacy levels is believed to provide insight into the effectiveness of current teacher training programs for the development of these skills. The information provided here can assist those involved both in the development of new teacher training programs and in identifying the in-service training needs of graduate preservice teachers related to ICT and self-efficacy.

1.1. Purpose of the Study:

The purpose of the study was to assess the levels of ICT competency among preservice teachers and their perceptions of academic self-efficacy, as well as whether ICT competency levels were a significant predictor of their academic self-efficacy. In order to achieve this purpose, answers were sought to the following questions:

In terms of the preservice teachers,

1. What is the level of ICT and academic self-efficacy?

2. Is ICT competency a significant predictor of academic self-efficacy?

3. Are ICT and ASE sub-dimensions a significant predictor of academic achievement?

2. METHODS

2.1. Study Model

A correlational screening model was used in the study, which is one of the general screening models. The concept of general screening models refers to screening arrangements applied to the whole universe or to a sample taken from it to assess the population as a whole in a population composed of numerous components (Bailey, 1982). On the other hand, the correlational screening model aims to determine whether there is a correlation between two or more variables and if so, the direction and magnitude of the correlation (Köse, 2010).

2.2. Sample and Population

Table 1. Distribution of the study group by gender, grade level, and registered program

Variable	Subgroups of the Variable	N	Percentage
Gender	Male	133	32,4
	Female	278	67,6
	Total	**411**	**100,0**
Grade	Second grade	170	41,4
	Third grade	154	37,5
	Fourth grade	87	21,2
	Total	**411**	**100,0**
Program	Physical Education and Sports Teaching	47	11,4
	Primary Mathematics Teaching	87	21,2
	English Teaching	33	8,0
	Preschool Teaching	32	7,8
	Psychological Counseling and Guidance	55	13,4
	Classroom Teaching	40	9,7
	Social Sciences Teaching	38	9,2
	Turkish Teaching	53	12,9
	Other (Computer and Instructional Technologies-Science Teaching-Music-Arts Teaching)	26	6,3
	Total	**411**	**100,0**

It was intended to reach all second, third, and fourth-grade students in Erzincan Binali Yıldırım University's Education Faculty Teacher Training Undergraduate Programs. Due to the importance of voluntary participation, the study was conducted with 411 students who volunteered to participate.

The frequencies and percentages of the study group according to gender, grade level, and teacher training undergraduate program were presented in Table 1.

2.3. Data Collection Tools

Besides the Personal Information Form, the Information and Communication Technology Competencies Scale for Pre-service Teachers (ICTS-PT) and Academic Self-Efficacy Scale (ASES) were used to collect data. The Personal Information Form contained information regarding the department, class, gender, and grade point average (GPA).

2.3.1. Information and Communication Technology Competencies Scale for Preservice Teachers (ICTC-PT)

The scale was developed by Tondeur et al. (2017) and adapted to Turkish language and culture by Alkan and Sarıkaya (2018). The 19-item scale had two sub-dimensions: ICT Competencies to Support Pupils for ICT Use (CSP-ICT) and Competency to Use ICT for Instructional Design (ICT-ID). A total of 11 items were included in the CSP-ICT dimension and eight items in the ICT-ID dimension. There were five points on the scale: I strongly disagree, I disagree, I am indecisive, I agree, and I strongly agree. A high score from the sub-dimensions of the scale indicated competency in the specified field, whereas a low score indicated incompetence.

Table 2. Internal consistency coefficients of ICTC-PT sub-dimensions

Subdimensions	Number of Items	Adapted Scale (n:206)	Current Implementation (n:411)
CSP-ICT	11	.91	,95
ICT-ID	8	.82	,92

The internal consistency coefficients calculated for the scale adapted for the sub-dimensions of ICT-PT in the current implementation were presented in Table 2. In the current implementation, the internal consistency coefficient calculated for CSP-ICT was .95, and the internal consistency coefficient calculated for ICT-ID was .92. Compared to the internal consistency coefficient calculated for the adapted scale, the internal consistency coefficients determined for the two subdimensions were found to be higher.

2.3.2. Academic Self-Efficacy Scale

It was developed by Kandemir (2010) and consisted of 19 items and three sub-dimensions. The sub-dimensions were Coping (ASE-CAP), Academic Effort (ASE-AE), and Academic Planning (ASE-APL). In the first dimension, there were 11 items, and in the second and third dimensions, there were four items each. A five-grade scale was used for the items on the scale, which were categorized as strongly disagree, partially agree, agree, considerably agree, and strongly agree. A high score on the scale and its sub-dimensions indicated high self-efficacy in the related field, while a low score indicated a low level of self-efficacy.

Table 3. Internal consistency coefficients of the Academic Self-Efficacy Scale and its sub-dimensions

Subdimensions	Number of Items	Original Scale (n:468)	Current Implementation (n:411)
ASE-CAP	11	.90	.96
ASE-AE	4	.78	.89
ASE-APL	4	.77	.87
ASE	19	.92	.97

The internal consistency coefficients calculated for the original scale and the current implementation for the ASE and its sub-dimensions were given in Table 3. As a result of the current implementation, the first factor was calculated with a coefficient of .96, the second factor with a coefficient of .89, the third factor with a coefficient of .87, and the whole scale with a coefficient of .97.

2.4. Data Analysis

Evaluation of the reliability of the scales was conducted based on the data collected. The research questions were answered using multiple and stepwise regression analyses, as well as descriptive statistics.

3. RESULTS

3.1. Findings related to preservice teachers' ASE and ICT competency levels:

The descriptive statistics regarding the preservice teachers' competency levels in ASES and ICT were presented in Table 4. As shown in the table, the total scores and subscale scores of the students for ICT and ASES were converted according to the hundredth system. The absolute success formula (Başol, 2008, p.126) was used to convert the scores into the hundredth system.

Table 4. Descriptive statistics on ICTC and ASE sub-dimension scores

Variables	Number of Items	$\bar{X}$	Sd	Based on the 100 System[*]
CSP-ICT	11	44,78	7,48	75
ICT-ID	8	31,97	5,59	75
ICT Total	19	76,74	12,53	75
ASE-CAP	11	38,31	10,47	61
ASE-AE	4	14,30	3,95	64
ASE-APL	4	13,56	3,92	60
ASE Total	19	66,17	17,61	61

[*]Calculated using the absolute success formula (Başol, 2008, p.126)

Based on the hundredth system, students' ICT self-efficacy perception was determined to be 75. It could be concluded from these findings that students had a high level of perception regarding CSP-ICT, ICT-ID, and ICT self-efficacy.

Based on the hundredth system, the students scored 61 for ASE-CAP, 64 for ASE-AE, 60 for ASE-APL, and 61 for ASE. The ASES and sub-dimension scores of the students were at a moderate level based on these findings.

The correlation coefficients between GPA, ICT-PT, and ASES sub-dimension scores were presented in Table 5. It was determined that there was a positive relationship between ICT and ASES sub-dimension scores, and these relationships were statistically significant ($p < .01$). While there was no significant relationship between GPA and ICT-ID, there was a significant relationship between all other sub-dimension scores.

Table 5. Correlation coefficients between GPA and ICTC and ASES sub-dimension scores

Variables	1. GPA	2	3	4	5
2. CSP-ICT	,104[*]				
3. ICT-ID	,076	,833[**]			
4. ASE-CAP	,200[**]	,434[**]	,477[**]		
5. ASE-AE	,227[**]	,407[**]	,407[**]	,837[**]	
6. ASE-APL	,163[**]	,412[**]	,421[**]	,917[**]	,811[**]

[*]$p < .05$ [**]$p < .01$

There were positive and significant relationships between the GPA and the sub-dimensions of ASES. There was a positive significant difference between GPA and ASE-AE ($r = .227$, $p < .01$), ASE-CAP ($r = .200$, $p < .01$), and ASE-APL ($r = .163$, $p < .01$). Whereas there was a positive and significant relationship between GPA and CSP-ICT ($r = .104$, $p < .05$), no significant relationship was determined with ICT-ID scores.
There was a .434 ($p < .01$) significant correlation between CSP-ICT and ASE-CAP, .407 ($p < .01$) between CSP-ICT and ASE-AE, and .412 ($p < .01$) between CSP-ICT and ASE-APL. There was a .477 ($p < .01$) correlation between ICT-ID and ASE-CAP, a .407 ($p < .01$) correlation between ICT-ID and ASE-AE, and a .421 ($p < .01$) correlation between ICT-ID and ASE-APL. These findings revealed that ICT sub-dimensions and ASES sub-dimensions were correlated with each other.

3.2. Findings regarding whether preservice teachers' ICT competence is a significant predictor of their ASE competence levels:

The results of the multiple linear regression analysis regarding ASE-CAP's prediction of the CSP-ICT and ICT-ID were presented in Table 6. In regression analysis, residual values must not be correlated. Based on Durbin-Watson values (2.059), the residuals in the relevant data set were not correlated. According to the one-way ANOVA, the established regression model was also statistically significant ($F_{(2-408)} = 61,591$, $p < .01$).

Table 6. Multiple linear regression analysis results of CSP-ICT and ICT-ID's prediction of ASE-CAP

Model	B	Std Deviation	Beta	t	p
(Constant)	8,248	2,819		2,926	,004[**]
CSP-ICT	,167	,110	,120	1,525	,128
ICT-ID	,706	,147	,377	4,804	,000[**]

R=,482 R^2=,232 R^2 = (Adjusted)=,228   [**]$p < .01$ $F_{(2-408)}$=61,591, $p < .01$
Durbin-Watson=2,059

The analysis results revealed that CSP-ICT and ICT-ID were both positive and significant predictors of ASE-AE (βCSP-ICT=.222, βICT-ID=.222). Both variables explained 17.7% of the variance in ASE-AE. The regression equation regarding CSP-ICT and ICT-ID's predicting ASE-AE could be written as "ASE-AE=4,038+,117 CSP-ICT +,157 ICT-ID." Multiple linear regression analysis results related to CSP-ICT and ICT-ID's predicting ASE-APL were presented in Table 8. While the analyzes revealed no relationship between the residual values (Durbin-Watson=1,947), the results also indicated the established regression model to be generally significant ($F_{(2-408)}$=47,728, p<.01).

Table 8. Multiple linear regression analysis results related to CSP-ICT and ICT-ID's prediction of ASE-APL

Model	B	Std Deviation	Beta	t	p
(Constant)	3,156	1,086		2,907	,004[**]
CSP-ICT	,104	,042	,198	2,453	,015[*]
ICT-ID	,180	,057	,257	3,181	,002[**]

R=,435 R^2=,190 R^2=(Adjusted)=,186   [*]p<.05 [**]p<.01 $F_{(2-408)}$=47,728, p<.01
Durbin-Watson=1,947

The results of the regression analysis proved that CSP-ICT and ICT-ID were significant predictors of ASE-APL (βCSP-ICT=.198, βICT-ID=.257). It was understood that both variables were positive predictors for predicting ASE-APL, and ICT-ID was a stronger predictor than CSP-ICT. Both variables explained 18.6% of the variance in ASE-APL. The regression equation regarding the CSP-ICT and ICT-ID's predicting the ASE-APL could be written as "ASE-APL=3,156+,104 CSP-ICT+,180 ICT-ID."

3.3. Findings regarding whether preservice teachers' ICT and ASE subdimension scores are a significant predictor of GPA:

The results of stepwise regression analysis regarding ICT and ASE sub-dimension scores' predicting GPA were presented in Table 9. The analysis started with the variable ASE-AE with the highest correlation with the GPA and continued by adding the other variables, respectively, according to the size of the correlation coefficient.

Table 9. The results of stepwise regression analysis regarding ICT and ASE sub-dimension scores' predicting GPA

Model	B	Std Deviation	Beta	t	p
(Constant)	2,607	,083		31,265	,000[**]
ASE-AE	,026	,006	,337	4,705	,000[**]

R=,227 R^2=,051 R^2=(Adjusted)=,049   [**]p<.01 $F_{(1-408)}$=22,133, p<.01
Durbin-Watson=1,813

According to the analysis results, the ASE-AE score was determined to be a significant predictor of the GPA (βASE-AE=.337, t=4.705, p<.01). The other variables were excluded from the model because they were not significant predictors. ASE-AE score alone explained 4.9% of the GPA. The regression equation regarding ASE-AE's predicting the GPA could be expressed as "GPA=2,607+,026 ASE-AE."

4. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

There was a good level of perceived ICT self-efficacy among pre-service teachers. Studies similar to this finding were found in the relevant literature, as well as studies that found different results. According to a study investigating graduates and students of education faculties (Gökçearslan, Coşkun, and Şahin, 2019), preservice teachers were determined to have high levels of ICT proficiency. In a study conducted with students enrolled in different undergraduate programs (Erten, 2020), preservice teachers were found to have sufficient knowledge, media, and technology skills. Additionally, there were studies that examined prospective teachers' perceptions of ICT self-efficacy at a lower level in the relevant literature. A study conducted on religious culture and ethics teacher preservice teachers (Çetin, 2017) revealed that the self-efficacy perception levels of religious culture and ethics preservice teachers were moderate. In a study conducted with pre-service science teachers (Şendağ, 2014), it was determined that the participants had a moderate level of ICT use self-efficacy. The different findings could be attributed to the fact that data was collected over different periods of time and from different groups. In addition, recent studies revealed higher levels of ICT literacy. Increasingly, ICT skills have become more important than ever in the process of fulfilling daily life routines. Possibly, this was one of the reasons why the students in the study group demonstrated a high level of ICT competence. An independent study could, however, be conducted on this topic.

A moderate perception of ASE was exhibited by participants in the sub-dimensions of ASE-CAP, ASE-AE, and ASE-APL. A review of the relevant literature revealed both similar and different findings. In a study (Aslan, Bakır, and Erkuş, 2020) about preservice teachers enrolled in the pedagogical formation education certificate program, it was determined that the academic self-efficacy perceptions of the participants were moderate. The academic self-efficacy perceptions of students enrolled in arts and computer science undergraduate and graduate programs (Ali, 2021) were also moderate. In another study on preservice physical education teachers (Alemdağ, Öncü and Yılmaz, 2014), it was found that the academic self-efficacy perceptions of the participants were above the medium level. Additionally, there were also studies in which preservice teachers' perceptions of self-efficacy were higher. Based on the results of a study that examined the self-efficacy perception of preservice primary school teachers (Bahar, 2019), it was found that there was a high level of self-efficacy perception among participants. In two separate studies (Tabancalı and Çelik, 2013; Gündoğan and Koçak, 2017), it was discovered that the academic self-efficacy beliefs of preservice teachers were high. It was important for preservice teachers to gain experiences that enhanced their perceptions of self-efficacy. In a productive human competence system, efficacy beliefs have played a key role. Regardless of the underlying skills, perceived self-efficacy contributed significantly to performance achievements (Bandura, 1997, p.37). To this end, it was considered important to focus on experiences that developed preservice teachers' self-efficacy perceptions.

CSP-ICT was not a significant predictor of ASE-CAP. In contrast, ICT-ID was a significant positive predictor of ASE-CAP. CSP-ICT appeared to be more closely related to general competencies whereas ICT-ID appeared to be more closely related to the

technological skills required by the teaching profession. During the process of planning and preparation, teachers needed some skills that were included in the instructional design. CSP-ICT and ICT-ID sub-dimensions were positive and significant predictors of both ASE-AE and ASE-APL. According to a study conducted on students enrolled in arts and computer science undergraduate and graduate programs (Ali, 2021), there was a positive and significant relationship between students' academic self-efficacy and their self-efficacy in using ICT. A positive relationship was found between teachers' self-efficacy beliefs about ICT and their use of ICT (Gbemu et al., 2020). Students with a positive attitude towards ICT were found to have higher academic self-efficacy levels in a study conducted on secondary school students (Ünal et al., 2019). In a study (Naemi, 2018), it was found that ICT had a significant effect on the academic self-efficacy of secondary school students. Adolescent students' self-efficacy and academic success increased by using ICT for up to three hours per day, according to a study (Mandal, 2020). These results suggested that pre-service teachers' ICT competencies also contributed to the development of their self-efficacy perceptions. In addition to contributing to improved performance of daily life routines, ICT competencies were considered important in terms of developing and applying professional skills. A crucial part of teacher training undergraduate programs was the incorporation of activities that supported ICT competencies into the content and practices of "information technologies" and "instructional technologies."

The sub-dimension scores of ASE-CAP, ASE-APL, and ICT were not significant predictors of GPA. However, the ASE-AE score was a significant positive predictor of GPA. According to the statistical results of the study, academic self-efficacy was found to strengthen the relationship between internet use and learning performance (Islam et al., 2019). A study on the teaching of Arabic (Naemi, 2018) found that ICT had a significant impact on the academic achievement motivation of secondary school students. Another study on foreign language teaching (Yokoyama, 2018) revealed that ICT and academic self-efficacy were effective in improving academic achievement. Based on the findings of a study involving secondary school teachers and students (Aktürk and Öztürk, 2019), academic self-efficacy was found to be an important factor affecting student academic achievement. Based on a study, self-efficacy beliefs were found to significantly increase learning success (Yusuf, 2011). Academic success appeared to be correlated with ASE-AE. Thus, experiences and activities designed to improve students' self-efficacy perception toward academic effort could also contribute to their academic success in teacher training programs.

Limitations

The results from this study are limited to students enrolled in teacher training programs at the university where the data were collected. However, since the entrance to teacher training undergraduate programs in Turkey is within the scope of similar conditions, it can give an idea about the qualifications of teacher candidates enrolled in other teacher training programs in Turkey discussed in this study.

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Conflict of interest

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