Analysis of Teachers' Research Competencies, Scientific Process Skills and the Level of Using Information and Communication Technologies

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Article Info	Abstract
	The aim of this study is to examine the research and ICT competencies and scientific process skills of teachers in different branches in Kazakhstan and the relationship between these three variables. The sample of the study consists of 258 teachers working in different cities of Kazakhstan in the 2022-2023 academic year. Teacher Research Competence Scale, Scientific Process Skills Scale and Information and Communication Technologies Competence Scale were used as data collection tools. Arithmetic mean, unrelated sample t test, one-way analysis of variance (ANOVA) and multiple linear regression analysis methods were used to analyze the data obtained. As a result of the research, it was determined that the participant teachers had moderate level of competencies in using research and information communication technologies and scientific process skills. Participant teachers' competencies in using research and information communication technologies and scientific process skills show significant differences according to their gender and branches. In particular, it was observed that teachers working in science and mathematics branches exhibited high research and ICT competencies and scientific process skills. Finally, significant relationships were observed between participant teachers' research and ICT competencies and scientific process skills. Scientific process skills were found to be the most important factor affecting teachers' research skills and competencies.

Introduction

In the information age, it is crucial to access information easily and effectively and to create new knowledge by using the information accessed, rather than having or storing information. The advancement of technology has changed the methods of accessing information, the way information is stored and the methods used to transmit information, and has led to the emergence of different methods (digital information sources, etc.) (United Nations Educational, Scientific and Cultural Organization, 2017). Thus, individuals need to be equipped with different knowledge and skills. Based on this information, educational institutions now need to be designed in a way that develops students' research skills, increases their ability to use technology, emphasizes higher-order skills such as

problem solving, analyzing, critical and analytical thinking, and improves their ability to work in groups (Bertiz, 2017; Hakkarainen et al., 2001; Kuyayama & Nkomo, 2021; Livingstone, 2004; Osman & Vebrianto, 2013).

While the presentation of information in digital environments enables individuals to access information easily and quickly, it also creates a complex structure. This complex structure requires individuals to have the knowledge and skills to obtain the information presented in electronic media through communication technologies, to use the information they obtain, to evaluate the information, and to format and re-present the information in the same environment (Bundy, 2004). For this, it is important for teachers to have these skills (Sünbül, 2000). OECD (1994), which conducted a research on how to improve the quality of teaching, emphasized that teachers should first learn to think themselves. Those who do not know how to think cannot teach thinking properly (Jeon & Park, 2014; Padilla, Okey & Dillashaw, 1983). Therefore, instructors should have learned to think. However, is this really the case? To what extent do teachers possess these skills? It is thought that investigating this issue will provide important data to the literature on the acquisition of these skills.

In short, research can be defined as the production of new knowledge through certain processes. As it approaches the quality of academic research, each research includes the following stages. Identifying the problem (subject/issue), preparing research proposals, planning the research, conducting the research, writing and reporting the research (Punch, 2005). In another way, it is categorized as recognizing the problem, defining the problem, estimating solutions, developing the research method, collecting and analyzing data, and making and interpreting decisions (Bailey, 1987; Cohen & Manion, 1988; Mason & Bramble, 1978). Research can be perceived as an art of "how to do it" rather than an academic field of study. Research requires skills and experience; it is an experience that requires the ability to conduct research independently and to criticize the research of others (Simon & Burstein, 1985).

Among teacher competencies, teachers' researcher identity is directly related to their sensitivity to scientific research and developments as well as their knowledge and skills related to scientific research methods, techniques and processes (Picciotto, 1997; Vanderlinde & van Braak, 2010). In this context, in Kazakhstan, scientific research methods courses have been included in the curricula of teacher training departments of universities in recent years in order to provide teachers with these expected characteristics. Studies on teachers' research competencies suggest that this competency of teachers is low (Tajibayeva et al., 2023; Nagima et al., 2023; Zhumash et al., 2021; Ospankulov et al., 2023; Zhussupbayev et al., 2023; Picciotto, 1997; Büyüköztürk, 1999; Vanderlinde & van Braak, 2010). The reasons for the low research competencies of teachers include the fact that the courses aiming to gain research culture are not included in the curriculum in undergraduate education, the teaching of the scientific research method, which is a course that should be learned by the student's participation in the activities, is theoretically based, and that they have not grasped the importance of the scientific research method course (Büyüköztürk, 1999).

According to Lind (1998), scientific process skills are the thinking skills we use to construct knowledge, think about problems and formulate results. Padilla, Okey and Garrard (1994) consider the use of any ability of an individual for scientific activity as a scientific process skill. In SAPA, it is defined as "teachable, usable abilities

that can be applied in many areas including the behavior of scientists" (Padillla, 1990). Scientific thinking and research are not unique to scientists. On the contrary, every individual who is scientifically literate and understands the nature of science can use these skills at every stage of his/her daily life to improve his/her quality and standard of living (Harlen, 1999). Of course, the dimensions in which these skills are used will differ according to individuals (Adelson, 2003; Badmus & Jita, 2022; Koro-Ljungberg, 2001; Umeh et al., 2022).

When the classifications with regard to scientific process skills are examined, it is seen that these skills are handled in two stages as "basic" and "integrated" scientific process skills. It would be useful to give brief information about these skills. Basic Scientific Process Skills These are the skills that form the basis of scientific process skills. These are: observing, inferring, classifying, measuring, predicting, using numbers, communicating, and using space-time relationships (AAAS, 1993; Jirout & Zimmerman, 2015; Sullivan, 2008).

Integrated Scientific Process Skills

Integrated scientific process skills include identifying and controlling variables, identifying by doing, hypothesizing, interpreting data, and conducting experiments (Ango, 2002; AAAS, 1993; Martin, Sexton & Gerlovich, 2002). When scientific process skills and research competence are considered together, revealing the status of teachers' scientific process skills will also provide an answer to the extent to which they can reflect these competencies to their lessons in a scientific sense. In addition, determining the research competence and scientific process skills of teachers will provide a clue about how much they can provide these skills and give importance to them in the education they will give to their students. It has become an important phenomenon to address research competence and scientific process skills together with contemporary instructional technologies. In this context, research competencies, scientific process skills and the competence of using information communication technologies were addressed with a relational approach in this study.

Information and communication technologies are considered to be a prominent tool in solving problems encountered in life and interacting with the social environment (Sime & Priestly, 2005). Teachers have the biggest role in the studies on ICT in educational institutions (Hew & Leong, 2011). For this reason, teachers' competencies related to information and communication technologies are important in many dimensions. These dimensions can be expressed as teachers' adapting to contemporary living conditions and closely following modern innovations and changes in technology, integrating information and communication technologies into teaching processes and using them to increase the quality of teaching, creating various applications and active learning experiences for students to gain the necessary knowledge and skills in the field of information and communication technologies (International Society for Technology in Education, 2020). When these dimensions are taken into consideration, teachers will have adapted information and communication technologies to their own lives on the one hand, contributed to the achievement of this goal of educational institutions that undertake the mission of preparing students for life on the one hand, and on the other hand, they will play an important role in helping students achieve the expected academic gains by using technological innovations in all courses.

For today's educators, the main competencies are defined in seven different areas: learner, leader, citizen,

collaborator, designer, facilitator and analyzer. When these seven different core competencies are examined, it is seen that competencies related to managing with technology, learning with technology, preparing for the digital world, triggering technological collaboration and providing opportunities with technology are frequently mentioned. It is stated that today's educators should be individuals who research, use, adapt, personalize and design technology (ISTE, 2017; Yılmaz & Sünbül, 2009). When the teacher competencies published by UNESCO (2011) are examined, it is emphasized that ICT is important for all branch teachers. In addition to basic hardware and software skills, teachers are expected to use productivity applications, web, communication and presentation software and management applications. In addition, teachers are expected to have the understanding of being educators and leaders to adapt ICT-enriched learning environments and innovations to their schools, as well as the knowledge and skills to use technology to acquire pedagogical knowledge to support their professional development. Similarly, there are studies indicating the importance of 21st century teachers not only having ICT skills but also combining these skills with content and pedagogy and transferring them to classroom environments (Mishra & Kohler, 2006; Tonduer et al., 2012; Watson, 2001).

Hazzan's study (2000) on teachers' perceptions of technology emphasized that teachers who have used technology in their own learning activities are more confident and positive in their perceptions of technology. Slough and Chamblee (2000) also pointed out that teachers who witnessed the positive contribution of technology in their teaching activities did not avoid using technology. These studies show that teachers should have experience and knowledge about technology integration. As a matter of fact, research has shown that teachers' knowledge about technology and their attitudes towards technology are highly correlated, and teachers who are more aware of technologies have more positive attitudes towards technology use (Kılınçer, 2022; Coffland, 2000). In his study, Manoucherhri (1999) stated that in addition to the lack of knowledge about technologies, teachers' knowledge about how to use technologies in teaching is insufficient. However, many studies (Galanouli, Murphy, Gardner, 2004; Jedeskog & Nissen, 2004) stated that the common point where all studies on the implementation of ICT in schools meet is that teachers should have the necessary knowledge and skills for the effective integration of ICT into the teaching and learning process (Boshuizen & Wopereis, 2003; Cartwright & Hammond, 2003; Herzig, 2004). In the light of this information; teachers need to integrate technology into education, manage the teaching process, develop materials suitable for the lesson, keep up with the developing technology, provide education to students while providing consultancy to the parents of these students, teach their lessons by taking into account the conditions of the school where they work and the individual characteristics of the students, and more importantly, know their students (Lim & Ching, 2004; Melle, Cimellaro & Shulha, 2003; O'Mahony, 2003).

Educational institutions, which have the responsibility of raising individuals who are suitable for the human profile that societies need, are expected to raise individuals who are equipped with computer and information literacy skills, who can use technology and who are self-learners. However, in order to be able to use these technologies, teachers' ICT skills and effectiveness, self-confidence and self-efficacy should be developed. The widespread use of computers in our daily lives and in education has led researchers to provide training on computer use in teacher training institutions, a topic that has been discussed for a long time. Teachers, who are the most important element in this process, should have some qualifications (Loucks-Horsley & Motsumuto, 1999; Pratt, 2002). In the light of these studies, it is thought that as the information communication skills of teachers and teacher candidates

increase, the level of effective teaching will also increase. One of the aims of education and training is to raise individuals who have research skills and can use information communication technologies and scientific process skills effectively. It is important that teachers who will provide students with these skills and competencies also have these skills. In this context, this study examines the scientific process skills, research competencies and competencies of teachers working in Kazakhstan in using information communication technologies. On this basis, answers to the following questions were sought in the study:

- What is the level of teachers' use of scientific process skills?
- What is the level of teachers' research competencies?
- What is the level of teachers' competencies in using information communication technologies?
- Do teachers' research competencies, scientific process skills and competencies in using information communication technologies differ according to gender variable?
- Do teachers' research competencies, scientific process skills and competencies in using information communication technologies differ according to the branch variable?
- What is the relationship between teachers' research competencies, scientific process skills and information communication technologies?

Method

In this study, the relational survey model, one of the general survey models, is used on the basis of the quantitative paradigm. A survey model is all of the processes that describe a situation in the past or present as it exists and are applied for the realization of learning and the development of desired behaviors in individuals. In the general survey model, in a population consisting of a large number of individuals or participants, a study is conducted on the whole population or a representative group of samples or samples in order to reach a general decision about the population. The correlational survey model is a survey approach that aims to determine the existence of co-variance between two or more variables. In the correlational survey model, it is tried to determine whether the variables change together and if there is a change, how it happens (Watson, 2015). In this context, in this study, the scientific process skills, research and information communication technology use competencies of teachers working in different schools in Kazakhstan were examined with a comparative and relational approach according to gender and branch variables.

The study population of the research consists of teachers working in schools in different cities in Kazakhstan in the 2022-2023 academic year. The study group of the research consists of 258 teachers working in provincial centers in Kazakhstan. The sampling method used in the study is convenience sampling. The reason for choosing this sampling method is to form the sample starting from the most accessible respondents until the needed group is reached (Jager, Putnick & Bornstein, 2017).

Data Collection Tools

The data were collected through "Personal Information Form" and "Scientific Process Skills Test", "Teachers' Research Efficacy Scale" and "Teachers' Efficacy Scale for Using Information Communication Technologies".

Scientific Process Skills Test

The Test of Integrated Process Skills II (TIPS II) developed by Burns, Okey, and Wise (1985) was used to measure teachers' science process skills. This test consists of 36 items to measure high-level science process skills (identifying and controlling variables, hypothesizing, identifying by doing, graphing and interpreting, and experimenting). The reliability of the original version of the test was tested by Burns, Okey, and Wise (1985) by calculating the reliability coefficient and it was found to be .86. The adaptation studies into Kazakh were conducted by the researchers using the KR-20 method. The test was piloted with a group of 236 teachers. The reliability coefficient for the whole measurement tool was calculated as .83. The reliability coefficients of the sub-dimensions of the scale were calculated as .68 for the "defining variables" dimension, .68 for the "controlling" dimension, .73 for the "hypothesizing" dimension, .78 for the "defining by doing" dimension, .76 for the "graphing and interpreting" dimension, and finally .80 for the "experimenting" dimension.

Teachers' Research Competencies Scale

The following process was followed in the development of the scale. Determining the theoretical structure, ensuring content validity and creating the item pool were carried out by reviewing the relevant literature (teacher research as a researcher). The literature review revealed that teachers' own research competencies, the benefits attributed to research, and the barriers to teachers' conducting research may be related. Considering this structure, an item pool consisting of 12 items was created. The scale items are on a Likert-type five-point scale. Examples of questions to determine teachers' competencies to conduct and benefit from research were added to the draft scale form and presented to three experts to be evaluated in terms of scope, meaning, comprehensibility and appropriateness. Based on the expert evaluations, two items were removed from the scale and some items were revised. In addition, the draft scale form was reviewed by a group of five teachers (master's program students) in terms of meaning, comprehensibility, appearance and response time, and as a result of this process, some items were corrected again in terms of expression. After this stage, the scale became applicable and was administered to the teachers in the sample.

The construct validity of the scale was determined by Exploratory Factor Analysis (EFA) conducted on the application data. Before the analysis, z scores ($z < 3$) were calculated for the application data and it was determined that there were no outliers. The suitability of the data set for EFA was evaluated with Kaiser Meyer Olkin (KMO) and Barlett Sphericity test. KMO value was calculated as 0.902. The result of Bartlett's Test of Sphericity [$\chi^2 = 6960.52$; $p < 0.05$) showed that the distribution was close to a normal distribution. In addition, the normality of the distribution was tested with skewness and kurtosis coefficients and it was understood that these coefficients were within the range of ± 1 and the scores did not show a significant deviation from the normal distribution. These results indicated that the data set was sufficient for EFA and the analyses were conducted.

Eigenvalues, variances and slope accumulation graph were analyzed to decide the number of factors. A single factor with an eigenvalue above 1 and a total contribution to variance of approximately 52.25% was identified. The factor loadings of the scale ranged between .44 and .81. The scale consisted of 10 items in total. The scale

consists of "not at all", "a little", "moderately", "quite" and "completely" options and is scored between 1-5. The higher the score obtained from the scales, the higher the perception of research competence. The reliability of the scale was determined by calculating Cronbach Alpha internal consistency coefficient. Cronbach Alpha internal consistency coefficient was calculated as .85.

Teachers' Competence Scale for Using Information Communication Technologies

A Likert-type scale was developed by the researcher to measure teachers' competence in using ICT. An item pool was created by analyzing the previously developed scales and the literature on information communication technologies. In order to ensure the content validity of the item pool, it was submitted to the expert opinion of three faculty members who have studies in the field of measurement and evaluation and information technologies. Feedback was received from the assessment and evaluation expert on the structuring of the items as outcome statements (e.g. ... being able to use computers, ... being able to follow technological developments, etc.) and from the information technology expert on the correct use of terminology related to instructional technologies. The draft scale form, in which necessary adjustments were made in line with these feedbacks, was organized in Likert format with a 5-point scale ranging from 'I am quite competent' to 'I am quite inadequate' and made ready for construct validity and reliability studies. The pilot application of the draft scale was applied to 280 teachers and calculations regarding construct validity and reliability were made based on the data obtained. For this purpose, firstly, the correlation matrix of 20 items was examined and it was seen that the correlation between variables was above .30 in many cases. The normality assumption of the data set was examined with skewness and kurtosis values. It was found that the skewness and kurtosis values of the data indicated a normal distribution (within ± 1). The KMO (0.932) and Bartlett Sphericity tests ($X2 = 5725.17$; $p=0.000$) conducted to test the sampling adequacy of the data set consisting of 20 items showed that the data set had sampling adequacy for factorization and multivariate normal distribution. Exploratory factor analysis of the scale items was conducted using Principal Component Analysis, one of the common methods. In the first analysis, it was seen that there were a total of 3 factors with eigenvalues above 1. Accordingly, the eigenvalue of Factor 1 is 15.01 and explains 51.16 of the total variance, while the eigenvalues of Factors 2 and 3 are 1.28 and 1.09 respectively and their contribution to the total variance is low. In addition to the difference between the eigenvalues, when the scree plot and the components matrix were analyzed, it was concluded that the measurement tool showed a single-factor structure. The item-total correlations calculated for the items in the scale ranged between 0.46 and 0.79. The reliability of the scale items in terms of internal consistency was calculated using Cronbach Alpha formula. Cronbach Alpha coefficient was calculated as 0.931. Therefore, it can be said that the scale has high validity and reliability.

Data Analysis Techniques

In the analysis of the data, arithmetic averages and standard deviations of the perceived competence scores of the scales were calculated. For the difference analyses, the normality assumption was examined in all subgroups, and parametric tests were used in the analyses since the data had normal distribution characteristics (skewness and kurtosis coefficients within ± 1 range). Accordingly, t-test for independent groups was used to determine whether there was a significant difference between the perceived competence levels according to the gender of the

participants; one-way Anova test and post hoc Tukey test were used to determine whether there was a significant difference according to the professional seniority variables. The significance level was taken as 0.05.

Findings

As seen in Table 1, there was no statistically significant difference between the general ICT competency perceptions of female and male pre-service teachers participating in the study (t(407)= 0.804, p> 0.0125). When the averages of female (x = 107.87) and male (x = 106.24) pre-service teachers' efficacy perceptions are examined, it is seen that both groups perceive themselves similarly adequate in terms of the competencies related to the information and communication technologies required by the teaching profession.

Table 1. Descriptive Findings on Teachers' Scientific Process Skills

Scientific Process Skills	N	Number of Questions	Mean	Std. Deviation	Achievement Rate
Identifying and controlling variables	258	12	11.81	3.13	0.98
Hypothesis formulation	258	9	6.12	2.19	0.68
Defining by doing	258	6	3.5	1.02	0.58
Creating and interpreting graphs	258	6	5.22	1.72	0.87
Experimentation	258	3	2.37	0.82	0.79
TIPS II Total	258	36	29.01	6.87	0.81

As seen in Table 1, the teachers showed the highest success in the dimension of "determining and controlling variables" with a total of 6 points and an average score of 11.82. This dimension is followed by the dimension of "creating and interpreting graphs" with a total of 5.22 points. Teachers achieved high success in these two dimensions. Teachers scored 2.37 points in the "conducting experiments" dimension and 6.12 points in the "forming hypotheses" sub-dimension, showing moderate success. In the 6-point "defining by doing" dimension, they scored 3.50 points and showed the lowest success. In total, the average of their scores from the 36-question test was 29.01. The fact that the teachers had an average of 29.01 from TIPS II means that they were 80% successful. This means that the science process skills of the teachers are above the middle level.

Table 2 shows the mean and standard deviation of teachers' scores on the information and communication technologies scale. In general, teachers received an average score of 3.28 on this scale. According to the five-point scale system, this average score indicates a moderate level of competence.

Table 2. Descriptive Findings on Teachers' Efficiency in Using Information and Communication Technologies

	N	Minimum	Maximum	Mean	Std. Deviation
Competence to Use Information and Communication Technologies	258	1	5	3.28	1.02

Table 3 shows the mean and standard deviation of teachers' scores on the research competence scale. In general,

teachers obtained a mean score of 3.04 on this scale. According to the five-point scale system, this average score indicates a borderline and moderate level of competence.

Table 3. Descriptive Findings on Teachers' Research Competence

	N	Minimum	Maximum	Mean	Std. Deviation
Research Competence	258	1	5	3.04	1.08

As seen in Table 4, 141 of the 258 participants in the sample were female and 117 were male. In all sub-dimensions of the test, no significant difference was found between gender and science process skills. However, it can be said that female teachers have higher levels of science process skills than male teachers in the dimension of hypothesis formulation. On the other hand, in the dimensions of creating and interpreting graphs and conducting experiments, male teachers obtained higher averages compared to their female colleagues.

Table 4. t Test Findings Regarding Scientific Process Skills According to Teachers' Gender

Scientific Process Skills	Gender	N	Mean	Std. Deviation	t	p
Identifying and controlling variables	Female	141	11.87	3.14	0.33	0.74
	Male	117	11.74	3.12		
Hypothesis formulation	Female	141	6.35	2.22	1.93	0.05
	Male	117	5.83	2.13		
Defining by doing	Female	141	3.60	0.98	1.78	0.08
	Male	117	3.38	1.06		
Creating and interpreting graphs	Female	141	4.54	1.59	-7.62	0.00
	Male	117	6.03	1.51		
Experimentation	Female	141	2.06	0.77	-7.24	0.00
	Male	117	2.73	0.71		
TIPS II Total	Female	141	28.43	6.80	-1.49	0.14
	Male	117	29.71	6.91		

Table 5 shows the mean, standard deviation and t values of the participant teachers' scores on the competence of using information and communication technologies. According to the analysis, a t value of 2.25 was calculated between the scale mean scores of the two groups. According to this finding, there is a significant difference according to gender in terms of competence in using ICT. Male teachers have higher ICT competence compared to their female colleagues.

Table 5. t Test Findings Regarding Teachers' Efficiency in Using Information and Communication Technologies According to Their Gender

	Gender	N	Mean	Std. Deviation	t	p
Competence to Use Information and Communication Technologies	Female	141	3.06	1.01	2.25	0.03
	Male	117	3.48	1.04		

Table 6 shows the mean, standard deviation and t values of the participant teachers' research efficacy scores. According to the analysis, a t value of 2.10 was calculated between the scale mean scores of the two groups. According to this finding, there is a significant difference in terms of research efficacy according to gender. It is understood that female teachers have higher efficacy compared to their male colleagues.

Table 6. t Test Findings Regarding Research Competence According to Teachers' Gender

	Gender	N	Mean	Std. Deviation	t	p
Research Competence	Female	141	3.17	1.10	2.10	0.04
	Male	117	2.89	1.03		

Table 7 shows the mean, standard deviation and F values of the participant teachers' science process skills scores in terms of their branches. According to the analyses, 6.21 F values were calculated for the scores of the four groups in the dimension of "determining and controlling variables"; 11.82 F values were calculated in the dimension of "hypothesizing"; 2.69 F values were calculated in the dimension of "identifying by doing"; 6.99 F values were calculated in the dimension of "creating and interpreting graphs"; 4.36 F values were calculated in the dimension of "conducting experiments" and 8.43 F values were calculated in the "TIPS II General Total" scores. A significant difference was found in all sub-dimensions and total scores of the science process skills scale except the dimension of identification by doing ($p<0.05$). In the graphing dimension, the highest mean scores were obtained by teachers in the branches of arts and sciences and science-mathematics. In the other dimensions and total scores of science process skills, teachers in science-mathematics branches had higher averages than their colleagues in other branches.

Table 7. F Test Findings Related to Scientific Process Skills of Teachers According to Their Branches

Scientific Process Skills	Branch	N	Mean	Std. Deviation	F	p
Identifying and controlling variables	Fine arts	75	12.40	2.33	6.21	0.00
	Language	67	11.01	3.67		
	Science-Mathematics	42	13.14	2.73		
	Social Fields	74	11.19	3.19		
	Total	258	11.81	3.13		
Hypothesis formulation	Fine arts	75	6.00	1.83	11.62	0.00
	Language	67	5.04	2.13		
	Science-Mathematics	42	7.29	1.70		
	Social Fields	74	6.54	2.39		
	Total	258	6.12	2.19		
Defining by doing	Fine arts	75	3.40	0.94	2.69	0.051
	Language	67	3.45	1.03		
	Science-Mathematics	42	3.90	0.69		
	Social Fields	74	3.42	1.19		
	Total	258	3.50	1.02		

Scientific Process Skills	Branch	N	Mean	Std. Deviation	F	p
Creating and interpreting graphs	Fine arts	75	5.74	1.00	6.99	0.00
	Language	67	4.88	2.11		
	Science-Mathematics	42	5.71	1.76		
	Social Fields	74	4.70	1.69		
	Total	258	5.22	1.72		
Experimentation	Fine arts	75	2.45	0.57	4.36	0.01
	Language	67	2.28	0.94		
	Science-Mathematics	42	2.70	0.91		
	Social Fields	74	2.18	0.80		
	Total	258	2.37	0.82		
TIPS II Total	Fine arts	75	29.99	4.82	8.43	0.00
	Language	67	26.67	7.51		
	Science-Mathematics	42	32.75	6.12		
	Social Fields	74	28.03	7.45		
	Total	258	29.01	6.87		

Table 8 shows the mean, standard deviation and F-values on the scores of the participants' proficiency in using information and communication technologies in terms of their branches. According to the analysis, an F value of 5.32 was calculated between the scale mean scores of the four groups. According to this finding, there is a significant difference in terms of the competence of using information and communication technologies according to the branch variable. According to Sheffe's test analysis, teachers in science-mathematics branch have higher ICT competence compared to their colleagues in language and fine arts branches.

Table 8. F Test Findings Regarding Teachers' Efficiency in Using Information and Communication Technologies According to Their Branches

	Branch	N	Mean	Std. Deviation	F	p
Competence to Use Information and Communication Technologies	Fine arts	75	2.95	0.75	5.32	0.00
	Language	67	3.25	1.05		
	Science-Mathematics	42	3.67	0.85		
	Social Fields	74	3.41	1.22		
	Total	258	3.28	1.02		

Table 9 shows the mean, standard deviation and F values of the research competence scores of the participant teachers in terms of their branches. According to the analysis, an F value of 11.64 was calculated between the scale mean scores of the four groups. According to this finding, there is a significant difference in terms of the competence of using information communication technologies according to the branch variable. According to Sheffe's test analysis, teachers in science-mathematics and social branches have higher research competence compared to their colleagues in language and fine arts branches.

Table 9. F Test Findings Regarding Research Competence According to Teachers' Branches

	Branch	N	Mean	Std. Deviation	F	p
Research Competence	Fine arts	75	2.52	0.89	11.64	0.00
	Language	67	2.99	1.06		
	Science-Mathematics	42	3.64	0.85		
	Social Fields	74	3.23	1.17		
	Total	258	3.04	1.08		

As seen in Table 10, the scales of thinking skills and competence in using information and communication technologies together are significantly related to the research competence dimension (R = .688, R2 = .469, p < .05). These two variables explain 46.9% of the total variance in research competence. When the t-test results regarding the significance of the regression coefficients are analyzed, it is seen that only science process skills are a significant predictor of research efficacy. The variable of information and communication competence did not have a significant effect on research competence.

Table 10. Multiple Linear Regression Analysis Results Regarding Whether Scientific Process Skills and Proficiency in Using Information and Communication Technologies Predict Research Proficiency

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Independent Variables	(Constant)	-0.095	0.213		-0.444	0.657
	TIPS II Total	0.096	0.010	0.612	9.518	0.000
	Competence to Use Information and Communication Technologies	0.108	0.068	0.102	1.584	0.114
R=.688; R^2=0.469; F= 114.327; p<0.05						

Discussion and Conclusion

In this study, the relationships between teachers' research efficacy, ICT use efficacy and scientific process skills in Kazakhstan were examined on a comparative basis. According to the findings of the study, teachers' research efficacy was found to be moderately to low. These findings are similar to the findings of studies conducted by Koshmaganbetova et al. (2020), Nikola (2021), Roman (2021), Syahrial et al. (2022), Waite & Davis (2006) in different teacher samples. Studies in the literature list factors such as the education system, time constraints, limited access to resources, deficiencies in professional development and research skills, and low motivation to conduct research as important reasons for teachers' low research efficacy (Koshmaganbetova et al. 2020, Nikola, 2021, Roman, 2021, Syahrial et al., 2022). Education systems may not provide teachers with adequate training and support in conducting research and accessing up-to-date information.

In addition, teachers may not have sufficient resources to conduct their own research and access information.

Especially in Kazakh schools, teachers are faced with many tasks, such as busy work schedules, lesson preparation and student assessments. In this situation, the time available for research may be limited, which may have hindered teachers from developing their research skills.

On the other hand, according to the research findings, teachers' research competencies differ according to their gender and branch. This situation shows that some teachers do not give enough importance to their own professional development or do not follow new information about their profession. According to Waite & Davis (2006), research is a process that requires time and effort from teachers. Teachers' low motivation for research may hinder the development of their research skills. Lovat, Davies and Plotnikoff (1995) pointed out the importance of the researcher's access to and use of resources in the research process. Teachers face limitations in accessing the necessary resources (books, articles, research data, etc.) to conduct research. This may negatively affect the development of research skills.

According to another finding of the study, Kazakh teachers' competencies in using information and communication technologies were found to be moderate and partially low. Studies conducted on teachers in different countries and samples support this finding (Basargekar & Singhavi, 2017; Buabeng-Andoh Goh, 2012; Casillas Martín, Cabezas Gonzalez & Garcia Penalvo, 2020; Kibici, 2022; Sigala, 2020; Hutchison & Reinking, 2011; Syvänen et al., 2016). In relation to this finding of the study, studies in the literature list the multifaceted problems of the education system in terms of technology integration, teachers' access problems to technology, lack of in-service trainings and support in this regard, and low motivation as reasons (Buabeng-Andoh Goh, 2012; Casillas Martín, Cabezas Gonzalez & Garcia Penalvo, 2020; Hutchison & Reinking, 2011; Kibici, 2022; Kilincer, 2021; Syvänen et al, 2016).

Education systems may not provide teachers with sufficient ICT training and support. Teachers may face limitations in accessing adequate training and resources on technology use. Teachers may not have sufficient technological infrastructure and resources in schools. This may lead to low competence in the use of technology. On the other hand, the lack of adequate training and support to improve teachers' skills in using technology and the lack of support mechanisms such as professional development programs, workshops or information sharing among teachers may be an important reason for low efficacy in this area. Kilinçer (2021) pointed out the importance of teachers' attitudes and motivation in proficiency in ICT technologies. Teachers' low attitudes and motivation and their anxiety about new instructional technologies may have negatively affected their competence in this subject.

According to another finding of the study, teachers' competencies in using ICT technologies differ according to their gender and branch. It was observed that female teachers had low ICT competence. Again, in terms of branch variable, teachers in science-mathematics fields exhibited high ICT competencies compared to their colleagues in other subject-areas. As a matter of fact, in the studies conducted by Danner and Pessu (2013), Ilomäki (2011), Kara (2021), Tzafilkou, Perifanou and Economides (2021), the ICT competencies of female teachers in different subjects were found to be low.

One of the variables of the research is teachers' scientific process skills. In general, Kazakh teachers' competencies regarding scientific process skills are at medium level. The scientific process skills of the participant teachers showed significant differences according to their gender and the branches in which they worked. According to further analysis, female teachers exhibited high skills in the dimension of hypothesis formulation, while male teachers exhibited high skills in the dimensions of graphing and interpretation and experimentation.

Again, in terms of scientific process skills, participants in the science-mathematics field obtained the highest averages. These findings are similar to the findings of Burke (1996), Cho, Kim & Choi (2003), Dowling & Filer (1999). According to Dowling & Filer (1999), in the process of implementing science process skills, teachers are not aware of these skills and try to teach the behaviors in the curriculum without realizing that they also teach science process skills to students. The activities carried out in the classroom are not specifically aimed at helping students acquire science process skills. According to Çepni et al. (2006), scientific process skills are more prominent in science and mathematics courses. In these courses, scientific process skills function as a foundation that facilitates learning, provides research methods, enables students to be active in learning, develops a sense of taking responsibility for their own learning and increases the permanence of learning. In this respect, teachers in the fields of science and mathematics have to include more activities related to scientific process skills as a requirement of their curricula. This situation positively affects their competencies in scientific process skills. As a result, it was observed that teachers' scientific process skills differed primarily according to the fields of study. Other factors that come to mind as a reason for this significant difference may be related to the quality and quantity of science and mathematics courses taken during higher education or secondary education.

The last finding of the study is the relationship between Kazakhstani teachers' scientific process skills, ICT competencies and research competencies. According to regression analyses, it was seen that having scientific process skills was particularly effective in teachers' research competence. These findings are similar to the findings of studies conducted by Anisimova, Sabirova & Shatunova (2020), Burns, Okey & Wise (1985), Cebrián,, Junyent & Mulà (2020), Rubin & Norman (1992), Scharmann (1989). It was concluded that teachers' scientific process skills and their competencies to conduct scientific research are positively related to each other. Accordingly, it can be said that as teachers' scientific process skills improve, their competencies towards scientific research improve, and likewise, as their positive attitudes towards scientific research improve, their scientific process skills improve. According to Solomon, Wilson, and Taylor (2012), research competence is based on needing information, using methods of accessing information, accessing information with these methods, comparing and evaluating information, establishing relationships with other information, and actively using scientific process skills as a whole.

In conclusion, teachers need to have their own science process skills, research, art, technology and communication competencies in order to develop their students' 21st century skills (Öztürk, 2017). Undoubtedly, there is a need for teachers who are equipped for such an environment. For this, teacher training institutions have important duties. Universities should give importance to scientific process skills, research competence and information communication technologies in their teacher training programs. A teacher will be productive as long as his/her scientific process skills, research competence and competence in using information communication technologies

are high. In this context, studies on scientific process skills, research competence and information communication technologies should be increased and teachers should be informed about their importance. Teacher training institutions should undertake the task in this regard. In order to generalize the results of this study, further studies should be conducted with large samples of teachers working at different levels and in more schools across the country.

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