

## Evaluation of the Program Effectiveness of Research Competence Development in Prospective Elementary School Teachers

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### ABSTRACT

To develop research competence in prospective teachers, a system of methods for diagnostics and formation of this competence in prospective elementary school teachers in the training process is designed. To diagnose the research competence, a series of techniques were used that allow subtle evaluation of each competence research component: axiological, emotional-motivational, cognitive, behavioral, and control-evaluation. These techniques also give the opportunity to assess the level of research competence formation. The study involved 102 students from Kazakh State women's teacher training university: students of the experimental group (50 people) were trained in accordance with developed methods of forming research competence; students in the control group (52 people) were engaged in a common program. The generalization of the experiment results shows that middle and low levels of research competence formation dominated in the experimental and control groups. In this study, we developed and piloted the course "Approach to the research competence formation in prospective elementary school teachers". The course was tested at the Kazakh State women's teacher training university. The diagnostic results showed that the level of research competence formation increased in the experimental group, whereas in the control group, indicators remained unchanged. Statistical data processing confirmed the accuracy of the changes.

### KEYWORDS

Research competence, elementary school teachers, professional training, components of research competence, ascertaining experiment, formative experiment, competence formation.

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## Introduction

Education is not only the volume of assimilated information, but also the ability of a person to act in various problem situations (Morais, Neves & Afonso, 2005; Syzdykbaeva & Khan, 2015; Ozarbayeva, 2016). A number of these situations is determined by the specifics of the life and educational events. Competence-based approach requires teacher flexibility, mobility, research skills, allowing him/her to adapt his/her professionalism to the uncertainty conditions in a rapidly

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changing environment (Cator, Schneider, & Vander Ark, 2014). An urgent task of higher career school is teaching students the ways of searching and processing scientific information through independent research practices. The need in information selection, the desire for independent search of necessary information, acquisition of fundamental knowledge that forms the theoretical basis of professional activities, the ability to create and implement new strategies and activities are the issues facing teachers (Khutorskiy, 2003; Bírová, Ocovay & Vasbieva 2016).

Competence is a synthesis of two components:

- 1) the presence of a specific set of competencies in a student (Shadrikov, 2004);
- 2) formed personal quality of an educated person, which expresses the ability to operate effectively, to achieve results (Molokova, 2006) and the specialist's mobility in the labor market.

Scientific competence is manifested in theoretical literacy, the mastery of psychological and pedagogical research methods, the ability to aggregate empirical data, to formulate conclusions, to present the results of the study (Hendriks et al., 2010). Components of research competence of teachers are the following (Alnoor & Yu, 2011; Derkach & Kuzmina, 1993):

- 1) Axiological is implemented in such qualities as humanism, respect, honesty, compassion, integrity;
- 2) Emotional-motivational is implemented in such personal qualities as initiative, desire for knowledge, positive attitude towards research activities;
- 3) Cognitive is implemented in such qualities as high intelligence, good memory, polymathy, attentiveness, thoughtfulness, diligence;
- 4) Behavioral is implemented in such qualities of the individual as a research activity, the pursuit of truth, originality, independence, initiative, subjectivity, creativity;
- 5) Controlling and evaluative is realized in such personal qualities as self-esteem, self-discipline, dedication, independence in judgment, courage in defending own views.

Thus, a general understanding of research competence is gained. Nevertheless, a common approach for the research competence development in prospective teachers is not represented. Developments on the research competence modernization concern mainly the prospective teachers of universities (Skotnikova, 2008) or prospective teachers of senior classes (Leontovich, 2001). Based on the research findings we may confirm that in former Soviet republics, the graduates of pedagogical universities are not ready for independent research work in the field of education, they may not act as its organizers (Triapitsyna, 2010). At the same time, in countries where research activities are implemented in the system of higher education, the research skills of prospective teachers strengthen their professional identity and contribute to the use of evidence-based approaches in teaching (Niemi & Nevgi, 2014; Naumescu, 2008). In these countries, the development of research competence is devoted to a separate topic in the course structure. This issue is also considered in connection with the annual workshops (Wildová, 2014).

A unified system of assessing the research competence level is still not represented. Studies mainly focus on one or more components (Derkach & Kuzmina, 1993) focus on axiological and emotional-motivational components) or use only qualitative methods, without quantitative data processing (Kazantsev

(2000) cites the results of generalization of observation experience). Accordingly, even if new developments appear in the sphere of research competence, there are no universal tools to measure the effectiveness of such programs.

### Aim of the Study

This article presents theoretical-methodological and practical results of research aimed at the development of research competence in prospective elementary school teachers.

### Research questions

What qualities are within the competence of the prospective elementary school teachers?

### Method

The content of experimental work consisted of ascertaining, formative and control steps. The study included 102 female students of the specialty "Pedagogy and methodology of primary education", Kazakh State Women's Teacher Training University. The students of the experimental group (EG, N = 50) were those who were trained in accordance with the proposed method of research competence formation. To the control group belonged students, not covered by the measures of formal education (CG, N = 52).

Ascertaining step of the experiment included a diagnostics of research competence development in students, using appropriate diagnostic tools (text projective techniques, questionnaires, self-assessment questionnaires). Criteria and indicators of research competence were studied (Table 1).

**Table 1.** Diagnostics program for levels of research competence formation in the student

Criterion (component)	Diagnostic methods
Axiological	Projective technique "Image of elementary school teachers in the conditions of primary education reformation"; The technique of studying value orientations of elementary school teachers; Questionnaire "Research competence as a professional value of modern elementary school teachers".
Motivational	The essay "What is research competence?"; The questionnaire "The attitude of elementary school teachers to the research competence" (Shamelkhanova, 2005); Diagnostics to identify students' motivation of success in the chosen profession.
Cognitive	Self-assessment method of theoretical and methodological readiness of students for professional activity (Ryndina, 2011).
Behavioral	Self-assessment method for research and creative abilities; Observation card "Expert assessment of research skills".
Control-evaluation	The self-assessment method for reflective skills; Questionnaire for the reflection study.

The formative stage of the research involved testing the developed elective course "Approach to the research competence formation in prospective elementary school teachers", consisting of lectures, practical classes, independent work of students, psychological and pedagogical workshop. The students of EG studied according to this technique, and students of CG – according to the standard.

The control step of the study consisted of re-diagnostics in the same complex of techniques (Table 1) in order to measure changes in the level of research competence formation.

### **Data, Analysis, and Results**

On the basis of theoretical and methodological analysis and empirical research, the complex methods for diagnostics and formation of research competence in prospective elementary school teachers in the training process are developed.

#### ***Diagnostics of the level of research competence development in prospective elementary school teachers. Diagnostics of research competence according to the first criterion (axiological)***

1. The diagnostic purpose of projective technique 'Image of the elementary school teachers in the conditions of primary education reformation' is the identification of value orientations of elementary school teacher through self-identification of the most important pedagogical values. Students were asked to write a profile of the modern elementary school teacher, determining the most important values that are needed in the primary education reformation. Students identified the following most important values: love for children; patience; education (polymathy); knowledge of modern technology; creativity; knowledge of the subject; sociability; activity (leadership, initiative).

The responses analysis revealed a tendency of students to underestimate the necessity of research competence formation in the characterization of the professional, highly sought in modern society.

2. To ascertain the importance of the value orientations, students were offered the technique of studying value orientations, based on the direct ranking of the list of 15 teaching values in alphabetical order. In the hierarchy of value orientations of CG and EG students, the most important are the following values:

1. Subject knowledge in the field of pedagogy and methodology of primary education - 31%;
2. Professional competence - 19%;
3. Communication with younger pupils, colleagues, parents - 10%;
4. Personal values - 9%;
5. Intellectual thinking - 7%;
6. Gnostic skills - 6%;
7. Creative skills - 5%;
8. Predictive ability - 3%;
9. Communication skills - 2%;
10. Construction and design abilities - 2%;
11. Interactivity, innovative readiness - 2%;
12. Research competence - 1%;
13. Self-education, self-development - 1%;
14. Information competence - 1%;
15. Special skills (specify) - 1%.

Based on the responses analysis, we can see that in the finished list of values, students of both groups show the same results as in a projective technique 'Image of the elementary school teachers': the foremost are subject knowledge and professional competence; and personal qualities and leading values, necessary for quality education of prospective elementary school teachers, are at the end of the

list (information competence, self-education, self-development, scientific competence).

3. The next task of the study was to determine, whether the value of students' is the actual professional value in the real situation or not. For this purpose, we used the developed questionnaire 'Research competence as a professional value of modern elementary school teachers'. The results of this procedure are presented in Table 2.

**Table 2.** The results of the diagnostics of research competence components

Groups	Low level		Average level		Above-average level		High level	
	Number	%	Number	%	Number	%	Number	%
<b>The results of questionnaire «Research competence as a professional value of modern elementary school teachers»</b>								
CG	10	19,2	19	36,5	19	36,5	4	7,7
EG	6	12	18	36	21	42	5	10
<b>The results of the questionnaire "The attitude of elementary school teachers to the research competence"</b>								
CG	22	42	19	36,5	8	15,3	3	5,7
EG	22	44	17	34	7	14	4	8
<b>Results on the questionnaire of A. A. Rean and V. A. Yakunin</b>								
CG	13	25	20	38,4	10	19,2	9	17,3
EG	12	24	14	28	13	26	11	22
<b>The results of the survey concerning theoretical and methodological readiness of prospective elementary school teachers to professional activities (Y. V. Ryndina)</b>								
CG	34	65,3	11	21,1	6	11,5	1	2
EG	37	74	7	14	4	8	2	4
<b>The results of the self-assessment diagnostic card of research and creative skills</b>								
CG	24	46	22	42	5	10	1	2
EG	27	54	14	28	6	12	3	6
<b>The results of the observational card "Expert assessment of research skills"</b>								
CG	21	40,3	25	48	5	9,6	1	2
EG	23	46	19	38	6	12	2	4
<b>Results of reflective skills self-assessment</b>								
CG	25	48	14	27	10	19,2	3	5,7
EG	22	44	12	24	12	24	4	8

About 36.5% of students in CG and 36% in the EG have the so-called critical level, and therefore do not imagine professional work of the prospective elementary school teachers.

19.2% of students in CG and 12% in the EG are absolutely not focused on the professional orientation of pedagogical University. These students are the most difficult group and do not take the necessity of forming research competence in the training process. However, in this category, it is possible to achieve some success through enhanced motivation and special (mostly individual) approach to learning.

These data are taken as the source to diagnose the axiological criterion of research competence.

### *Diagnostics of research competence according to the second criterion (motivational)*

1. The results of writing the essay ‘What is research competence?’ in both groups of ratees are similar in content: research competence for students – is the quality, necessarily associated with research activities, scientific work, and therefore, very far from the practical activity of elementary school teachers. In the opinion of students of both groups, this quality of teachers is desirable, but not necessary in the professional activities. Here is one episode of the essay: ‘... I am a prospective elementary school teacher, the most important for me is to learn a child how to write and read... There are several requirements, among which the most important is to love the child... At the same time, the research competence is probably the study, scientific work. For example, I should write an article or describe my experience. This is difficult for me, it is not clear, leave it to the resource specialists, prominent educators, scientists... What can I write at the beginning of my professional career?’

Thus, students do not understand the meaning of science and practice interaction, the necessity of forming research competence as a component of professional competence.

2. To identify the attitude of students towards research competence, the N. A. Shamelkhanova (2005) questionnaire was upgraded. The aim of the survey was to identify the attitude of students to the chosen specialty and future professional activity, the awareness degree in the need of educational process organization by methods of scientific cognition. According to the results of the survey, it was possible to see the degree of motivation development, need in professional activities, academic interests, aspirations, ideals, and attitude to professional work. The answers to the questionnaire showed that the majority of students in both groups vaguely imagine the importance of scientific methods in the organization of pedagogical process (Table 2).

3. Diagnostics on the identification of students' motivation in the chosen profession was carried out using A. A. Rean and V. A. Yakunin questionnaires (Badmaeva, 2004), consisting of 14 questions. For the answers ‘Yes’, 4 points are assigned, ‘Probably, yes’ – 3 points, ‘Cannot say’ – 2 points, ‘Probably no’ – 1 point, ‘No’ – 0 points. The diagnostic results are presented in Table 2.

The students of both groups placed on the fourth (CG) and third (EG) positions out of nine, i.e., it can be stated that they like it in a small degree. However, more than 45% of respondents answered the question: ‘Are you going to work as an elementary school teacher after graduation?’ with rather ‘Yes’ than ‘No’.

In both groups of ratees, there is a desire to know more about pupils, to understand their condition, actions; there is an interest in monitoring the pupils' behavior, their personality development. They get pleasure from information transmission and conversion. Students may not be able to develop their own pedagogical practices, because the professional knowledge is not enough and they have not developed sustainable techniques and ways of organizing their activities.

The majority of the respondents answered ‘Probably no’ and ‘No’ to the question: ‘Do you have the ability to see the process of education and in accordance with this design the whole learning process seamlessly and intelligently, focusing on the formation of the given qualities, knowledge, skills and behavior of the student?’

### ***Diagnostics of research competence according to the third criterion (cognitive)***

The method of cognitive readiness self-evaluation to professional activity (Ryndina, 2011) is aimed at reflecting and determining the actual level of theoretical and methodological readiness to implement professional activities, based on self-assessment of knowledge, skills and personal qualities. The technique consists of 18 questions, answering which, students were asked to rate the degree of relevant knowledge, skills and personal qualities.

In CG, low levels of theoretical and methodological preparedness of students to professional activity were detected in 65.3% of students, 21.1% of the students corresponded to the average level, 11.5% – above average, and the highest level was detected in 2% of the students. In the EG: a low level of theoretical and methodological preparedness of students to professional activity were detected in 74% of the students, 14% of students corresponded to the average level, 8% – above average, and the highest level was detected in 4% of the students. Data on cognitive criteria are presented in Table 2.

### ***Diagnostics of the research competence according to the fourth criteria (behavioral)***

1. The purpose of self-assessment of research and creative skills is to determine the current level of their formation based on self-assessment. The approach provides the following criteria for the evaluation of research and creative skills: 5 – the ability is pronounced; 4 – the ability is formed; 3 – the ability takes place; 2 – the ability is formed to a small extent; 1 – the ability is not formed. Statements were proposed to the participants of the experiment. They evaluated the formation level of experimental and creative skills in accordance with the designated criteria.

The results study of the self-assessment of research and creative skills allows us to conclude the low level of their manifestation.

Thus, students with the lowest values received the ability to formulate and justify a research topic; to summarize and systematize the results of their professional activity; to determine the most effective ways of solving the problems of the research; to predict outcomes of professional activities; to rebuild ways of working in a changing environment; implement the self-organization of professional activity; to use the methodological knowledge, research skills and abilities in practical activities; to make unconventional and innovative solutions.

The following abilities were more appreciated: to work independently with different sources of information, including the latest information technologies and databases; to use logical methods of thinking (analysis, synthesis, classification, comparison, analogy, etc.); to plan your presentation or performance with citations, annotations, peer reviews; to make recommendations. The results of the diagnostic card are presented in Table 2.

2. Observation card 'Expert assessment of research skills' confirmed the previously obtained results concerning the behavioral criterion.

Students, who scored more than 41 points, can be characterized by curiosity in various fields; they are able to perceive and describe the object from different points of view. They are able to put forward different ideas, offer unusual, innovative, original ideas to solve problems. They quickly respond to errors and inaccuracies made by the teacher or other students, and correct them. They are willing to participate in the experiments, debates and discussions; they can



convince the interlocutor of the truth of words. They express their thoughts and cite various sources, etc.

Most of the ratees marked these characteristics with ‘rarely’ and ‘sometimes’ in CG: 40,3%; in EG: 46%. Based on observations, in CG 48% of students corresponded to medium level, 9.6% of students were above average, and the highest level was detected in 2% of the students. In the EG, 38% of students corresponded to the average level, 12% of students were above average, the highest level was detected in 4% of the students. The results of this procedure are presented in Table 2.

### ***Diagnostics of the research competence according to the fifth criterion (monitoring and evaluation)***

The goal of the reflective skills self-assessment is to determine initial level of their formation. The approach provides the following levels of reflective skills assessment: 5 – the ability is pronounced; 4 – the ability is formed; 3 – the ability to more or less developed; 2 – the ability is formed to a small extent; 1 – the ability is not formed. Statements were proposed to the participants of the experiment. They evaluated the formation level of experimental and creative skills in accordance with the designated criteria.

Thus, students with the lowest values received the ability to comprehend original pedagogical problems; to evaluate ongoing professional activity in the following characteristics: problem, topic, research object, its subject, tasks, hypothesis, etc. More appreciated are the abilities: to analyze the experience of others in order to use it in their own activities; to analyze their own feelings and experiences; critically evaluate their own actions and behavior. In general, students showed a medium-low level of reflective skills development.

The results generalization of the level of research competence development according to the control and evaluation criteria are presented in Table 2.

The results of the survey are the same for the reflection study. The ratee is offered a number of positions; in each pair, he/she selects one position, which is preferable. The answers are compared with the key. In case of identity of the ratee’s answers on this opposition with the answer key, it is assigned 1 point, in case of a mismatch - 0 points.

### ***Overall assessment of the level of research competence formation in prospective elementary school teachers***

Next, the scores for all components of research competence were calculated. The results are presented in Table 3.

**Table 3.** Consolidated data of the ascertaining step of the study according to all components of research competence

Levels	Components of research competence									
	Axiological		Motivational		Cognitive		Behavioral		Control-evaluation	
	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG
L	10	6	18	17	34	37	22	25	25	22
A	19	18	19	16	11	7	24	17	14	12
AA	19	21	9	10	6	4	5	6	10	12
H	4	5	6	7	1	2	1	2	3	4

Consolidated data of the ascertaining step of the research according to the levels of research competence are presented in Table 4.



**Table 4.** Consolidated data of the ascertaining step of the research according to levels of research competence

Groups	The levels of research competence (ascertaining step of the research)							
	Low		Average		Above average		High	
	Number.	%	Number.	%	Number.	%	Number.	%
Control	22	42,3	17	32,6	10	19,2	3	5,7
Experimental	21	42	14	28	11	22	4	8

Further, a statistical test of differences between EG and CG was conducted. Since we used rank scale of measurements in the diagnostics, mathematical processing of the obtained data required the use of Mann–Whitney U test.

The results of the statistical test showed that the empirical value of U is in the zone of insignificance, which confirms the hypothesis  $H_0$  - the formation level of research competence of the two groups does not differ.

Generalization of the results of ascertaining experiment allowed us to draw some conclusions.

At the beginning of experimental work, the medium and low levels of research competence formation dominate (in CG - 42.3% and 32.6%, and in EG - 42% and 28%), and the lowest rates of research competence formation in students were obtained according to cognitive and behavioral criteria: 65,3%, in CG, and 74% in the EG. Ascertaining experiment allowed establishing the reasons for the low level of research competence formation in students: students have mainly theoretical and focused training, which does not contribute to the formation of their research competence; therefore, they do not seek to develop their subjective being. A system of motivational-valuable attitude to the carried out professional activities is not established by the methods of scientific cognition.

Educational environment of University does not motivate students enough to be active in current professional activities. Educational environment does not have enough methods and means to implement this position in students of current professional activities.

### ***Program of research competence development in prospective elementary school teachers***

Logic of the formative step of the study involves the organization of practical activities aimed at the formation of each component of research competence, in accordance with the stages: understanding, awareness and implementation.

Teaching served as means of testing the elective course ‘Approach to the research competence formation in prospective elementary school teachers’ that includes: lectures (15 hours), practical classes (15 hours), independent work of students (40 hours), which is 2 credits and educational psychology practicum 1 credit. Students of the experimental group were studying according to this method.

The goal of the course is focused on the needs of students in the formation of the research competence in the training process. Moreover, the purposes are determined with the initial level of students' research competence based on the developed criteria and assessment using a variety of techniques.

Let us consider the content of the course ‘Approach to the research competence formation in prospective elementary school teachers’.

Introductory lecture: introduction to the elective course, its structure, basic provisions, forms of work, methods of diagnostics and control.

1. The philosophical foundations of research competence.

Purpose: to have a view on philosophical ideas, paradigms, scientific approaches, principles, logic of research, research in education.

2. Conceptual bases of research competence.

Purpose: to know the conceptual basis of competence approach in education; the nature of research competence, its place and importance in training.

3. The technological basis of research competence.

Purpose: to know the methods, approaches, techniques, and technologies of the scientific research organization, for its skillful use in the organization of the educational process, to be able to create a research project, to be methodologically and technically competent in order to organize the educational process.

The final lesson.

Purpose: reflection of the result of the study course and research competence formation.

We have found the optimal combination of frontal, group and individual work, and such restructuring of the educational process, in which all its elements are aimed at ensuring the effectiveness of developing students' research competence as a personal quality through consistent ascent to higher and higher levels of its formation.

Lectures and seminars were the leading pedagogical means covering joint reading and discussion of texts by students (scientific, educational), reflective workshops, research situation, filling 'Portfolio of research competence development', and many others.

The awareness stage included a reflection of the current experience and the formation of the concept 'I am a prospective elementary school teacher – researcher'. At this stage of pedagogical work, the self-programming of self-development trajectory was used, through which educational, research, current professional activities, became desirable, attractive, fun to participate.

The analysis of the different structures of 'self-concept', developed by the researchers (Berns, 1986), allowed us to represent the structure of the concept 'I am a prospective elementary school teacher – researcher' in the following way (Table 5).

The basis for the construction of the concept 'I am a prospective elementary school teacher – researcher' was the psychological mechanism of constant overcoming of internal contradictions between the existing level of research competence formation ("I am Real") and some imaginary (simulated) condition ("I am Ideal").

**Table 5.** The structure of the concept "I am a prospective elementary school teacher - researcher"

The concept of "I am a prospective elementary school teacher - researcher" as a set of representations of the subject about himself as a prospective elementary school teacher - researcher	
↓	↓
"I am Real"	"I am Ideal"
↓	↓
The image of yourself in the present	The image of yourself as a prospective elementary school teacher with research competence

Work on realization of students' own concept of 'I am a prospective elementary school teacher – researcher' included the following steps:

The first stage is concept development. At this stage, the students predicted and determined the purpose, content, and methods of forming the research competence in the near and distant future.

The second stage – implementation of the concept 'I am a prospective elementary school teacher – researcher'. Direct process of research competence development.

The analysis of psychological and pedagogical research has allowed identifying the following factors for successful implementation of the concept 'I am a prospective elementary school teacher – researcher':

- confidence in having the basic research qualities, abilities, skills, necessary for successful and efficient implementation of professional activities;
- active participation in educational, research, current professional activities;
- aspiration to self-realization, which stimulates the generation of new goals, values, and manifests itself in the search and the development of new skills;
- the maximum liability;
- team spirit, cooperation and creative atmosphere;
- self-learning;
- value orientations based on social and ethical values;
- aspiration to innovation, which is based on a deep analysis of the contradictions of the present that allows you to respond quickly to external conditions and change them.

The third stage – correction of the concept of 'I am a prospective elementary school teacher – researcher'. At this stage, students acquire skills to assess the achieved results of the activities, skills of reasons' analysis that determined the obtained result, make adjustments in activities on further implementation of the concept.

Assessing the research trajectory of self-development, students answered the following questions: What is my perspective? (level of research competence formation)? What I can do today? What I want to learn? What knowledge and skills do I lack? What do I need to do (development program)? What are my achievements (results)?

Thus, forming the concept of 'I am a prospective elementary school teacher – researcher', the students analyzed the objective and subjective reasons that lead to achievements, acted as subjects in your life, organizing their development as researchers.

Significant role in the process of research competence formation in prospective elementary school teachers is devoted to training, which was intended to form the value attitude and motivation to current professional activities in students.

The training program provided for the communicative-creative exercises; exercises on forecasting the consequences of decisions; exercises to develop prognostic solutions; exercises involving the analysis of situations and decision-making, etc.

Pedagogical practice is a model of future professional activity. Therefore, during experimental work, the final stage of the forming experiment was implemented in the process of pedagogical practice.

The third pedagogical condition of research competence formation is the creation of an educational research community of students, University

teachers/instructors and elementary school teachers as a certain space of research competence formation in students. The task of creating this community (not just for the period of pedagogical practice) is open communication of elementary school teachers, University teachers/instructors and students with the aim of developing research competence in the latter.

The 'immersion' into a real professional activity and the training methods of professional activities are of great importance, as well as the methods of scientific knowledge: when building and organization of a lesson, educational activities, interaction with the teacher, working with students, parents, etc.

Within this space, the University formed the Department of 'Pedagogy and methodology of elementary education', which organized a series of training seminars for elementary school teachers. The workshop topics were determined through surveys of teachers. The most pressing issues were the inability of elementary school teachers to write an article (they imagine it as writing about the development of their best lesson using modern pedagogical technologies), to organize research activities with the junior student, to prepare the necessary reporting documentation, and others. Organization of pedagogical process using methods of scientific knowledge is new and unknown to them.

Our work has created unique, occurring nowhere else (neither in the lecture nor at the workshop) internal conditions for critical self-examination, intense experiences and satisfaction with the research activities, and hence for the acquisition of sustained interest to it, finding a personally significant meanings.

Using diagnostic methods (questionnaires, surveys, tests, etc.), students learn not only the organization of research, methods of processing and interpretation of the data, but they are also convinced in the need for their use in the normal educational process. The more exercises, the more chances for students to learn some research activities.

### *Evaluation of the program effectiveness of research competence development*

In the control step of the study, we used the same diagnostic tool as on the ascertaining step.

Generalizing the obtained data according to the axiological criterion, we noted that in the EG, there was a significant change, low level of self-evaluated research competence as professional value amounted to 0%, medium level decreased by 18%, above average level increased by 6%, and high level increased by 24%. The results of the CG group according to the axiological criteria have remained virtually unchanged.

The diagnostic results of the control step allowed identifying four main levels of success motivation in the chosen profession: high, above average, average, low. In the CG, the levels of motivation and success in the chosen profession remained unchanged: low level - 25%, average level - 38,4%, above average level - 19,2%, high level - 17,3%. In the EG, the levels of motivation and success in the chosen profession were as follows: low level - 1%, average level - 11%, above average level - 57%, high level - 31%.

The diagnostic results of the control step allowed us to determine the levels of theoretical and methodological preparedness of students to professional activity. In the CG, we discovered the following changes: low level corresponded to 28.8% of students (decrease by 36.5%), average level - 55.7% of students (decrease by 34.6%), above average level was 13.4% (increase by 1.9%), high level

remained unchanged at 2%. In the EG, the following changes were detected: a low level of theoretical and methodological preparedness of students to professional activity amounted to 4% (decrease by 70%), average level corresponded to 14% of students, above average level - 54% (increase by 46%), high level corresponded to 28% of the students (increase by 24%). Significant changes in both groups of ratees are connected with the study of the elective course 'Approach to the scientific and pedagogical research' in the CG and experimental elective course 'Approach to the research competence formation in prospective elementary school teachers' in the EG. One of the main components of these courses is the acquisition of methodological knowledge.

The results of the control step of the research according to behavioral criterion have shown that in CG, the assessment of research skills remained unchanged: low level amounted to 40.3% of students, the average level corresponded to 48% of students, above average level - 9.6% of students, high level was detected in 2% of the students. In the EG, positive qualitative changes were detected: low level amounted to – 4% of students (an increase by 42%), average level corresponded to 22% of students (an increase by 16%), above average level - 48% of students (an increase by 36%), and high level was detected in 26% (an increase by 22%) of students.

The results of the control step of the study according to the control and evaluation criterion (the criterion of reflective skills) have shown that the results in CG remained unchanged, students in the EG have scientific and professional knowledge of all aspects of educational activities: academic, educational, and social-pedagogical. They know how to analyze a specific teaching situation, show a willingness to adapt, supplement or change the lesson plan, the program of educational activities, forms and methods of training according to specific conditions in order to achieve optimal results. Moreover, they demonstrate the ability to predict the consequences of their professional actions, etc. The data of the control step of the study are presented in Table 6.

**Table 6.** Consolidated data of the control step of the study according to the components of research competence

Levels	Components of research competence									
	Axiological		Motivational		Cognitive		Behavioral		Control-evaluation	
	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG
L	9	0	16	1	15	2	22	1	25	2
A	19	9	20	9	29		24	12	14	10
AA	20	4	10	25	7	27	5	25	10	25
H	4	7	6	15	1	14	1	12	3	13

Consolidated data of the control step of the research in groups are presented in Table 7.

**Table 7.** Consolidated data of the control step of the research

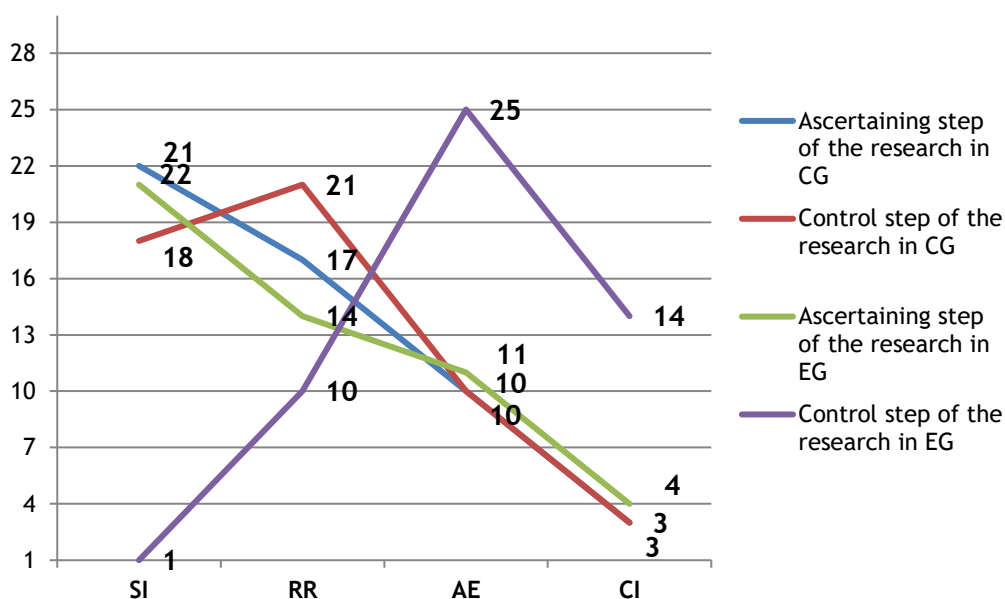
Groups	The levels of research competence (control step of the research)							
	Low		Average		Above average		High	
	Number.	%	Number.	%	Number.	%	Number.	%
Control	18	34,6	21	40,3	10	19,2	3	5,8
Experimental	1	2	10	20	25	50	14	28

To evaluate the effectiveness of the developed approach for the research competence development, we compared the results at the beginning and end of

the experiment (Table 8). The results of the comparative analysis are presented in Figure 1.

**Table 8.** Comparative data of the ascertaining and control steps of the study

Groups	Consolidated data of the ascertaining step of the research according to the levels of research competence							
	Low		Average		Above average		High	
	Ascrt.	Contr.	Ascrt.	Contr.	Ascrt.	Contr.	Ascrt.	Contr.
CG	22	18	17	21	10	10	3	3
EG	21	1	14	10	11	25	4	14



**Figure 1.** Data comparative analysis of ascertaining and control steps of research in groups

Such experiment with the statistical data processing was carried out for the first time.

As can be seen, at the control step of the study there is a positive dynamics of forming quality, namely: low level of research competence formation has decreased by 40%, the average level has increased by 8%, above average level has increased by 28%, high level has increased by 20%.

We will present the results in CG: low level of research competence formation has decreased by 7.7%, the average level has increased by 7.7%, above average level and the high level have remained unchanged.

Statistical test of differences significance between groups using Mann–Whitney U test showed that the empirical value of U is in the area of significance. Thus, we confirmed the hypothesis  $H_1$  - the formation of research competence of the two groups is different.

As the hypothesis  $H_1$  is confirmed, we determine whether there is a shift in the obtained results or not. To verify changes, we used the Wilcoxon rank-sum test. The received empirical value of T is in the area of significance, which confirms the hypothesis  $H_1$ : there are changes in the formed value. Thus, we

confirmed the positive dynamics of forming quality and the intended hypothesis of the study.

## Discussion and Conclusion

In the conducted study, we have tested the program of a comprehensive diagnostic of research competence in prospective elementary school teachers and tested methods for increasing the level of research competence. Summarizing the data according to the levels of research competence, we can say that in the EG, low level has decreased, while the above average and high levels have increased; at the same time, in the CG, low and average levels have slightly decreased, while above average and high levels remained unchanged. Mathematical data processing confirmed the accuracy of the changes: students who studied according to the course 'Approach to the research competence formation in prospective elementary school teachers', have shown a generally higher level of research competence formation than students of traditional courses.

It should be noted that in the studies of (Pantića & Wubbels, 2010), the teachers themselves have recognized the following important aspects of professional competence: a value sphere, knowledge of the subject, their own professional development and (to a lesser extent) understanding of the education system and the need of contribution to its development. These data confirm the importance of the study and development of research competence, although it is recognized that in different societies at a certain time, the importance of the individual professional competence of teachers may be different.

The formation of axiological and emotional-motivational component indicates that prospective teachers understand the importance of research competence and aims at its development. In Kazakhstan (where the study was conducted), teachers are rarely motivated to self-development in this direction, due to historical reasons and the predominance of values of Soviet and post-Soviet educational systems (Khairullina et al., 2016). In Western studies (Niemi & Nevgi, 2014), it is concluded that prospective teachers understand the need for the development of research skills and see this as a benefit to their professional development. We can conclude that the proposed approach is universal due to the coverage of all components of research competence, and therefore, is applicable to a sample of elementary school teachers in any country.

In the experiment, indicators of cognitive and behavioral components of research competence have also increased (in the EG); the formation of these components indicates that the prospective teacher is competent in the field of scientific thinking and possesses the skills to conduct scientific research. This is especially important in teaching science subjects, but it is also relevant in the training of elementary school teachers (Wildová, 2014), as it promotes the formation of a general culture of dealing with scientific knowledge.

In the UNESCO program "Education for Sustainable Development" (ESD), the declared values are the responsibility, critical thinking, and creativity. The lesson on the developed course contributed to the development of autonomy in finding information, taking responsibility for the professional development, expand horizons regarding the content of courses and teaching methods in prospective elementary school teachers. These qualities allow us to meet the challenges of life in modern society; they contribute to the maintenance of the ESD discourse (Naeem & Peach, 2011).



The most important limitation is the use of self-assessment methods (questionnaires, surveys). These methods allow making a quantitative assessment, but not delving into the issue. We used only one projective technique and one technique of systematic observation. We did not assess the results during the experiment, but only before and after. We did not conduct extended interviews to refine and deepen understanding of the obtained results. Accordingly, the expanding of methodological base is one of the directions for further research in this area. Other directions for further research are the impact assessment of the research competence of elementary school teachers on their own professional identity, and tracing the influence of research competence on changes in teaching approaches, if such changes occur.

### Implications and Recommendations

The article presents the results of experimental work for the study and formation of research competence in prospective elementary school teachers in the process of professional training, the mastery of which will allow predicting and designing the educational process by methods of scientific cognition.

Generalization of the results of ascertaining experiment allowed us to conclude that middle and low levels of research competence formation dominate in the experimental and control groups. The lowest rates of research competence formation in students were obtained according to cognitive and behavioral criteria: 65,3%, in CG, and 74% in the EG. Ascertaining experiment allowed establishing the reasons for the low level of research competence formation in students: students have mainly theoretical and focused training, which does not contribute to the formation of their research competence; therefore, they have not established a system of motivational-value attitude to professional activity by methods of scientific cognition. Educational environment of University does not motivate students enough to be active in current professional activities. It does not create conditions where all participants are able to build their path of professional self-development; it is not a system of opportunities for the formation of a research position of students.

With the aim of developing research competence, the elective course 'Approach to the research competence formation in prospective elementary school teachers' was developed and its innovative testing in the education system was implemented. The diagnostic results after the course showed that in the experimental group, the level of research competence formation increased, whereas in the control group, the indicators remained essentially unchanged. Statistical data processing confirmed the accuracy of the changes.

Presented in the article theoretical-methodological and practical developments are aimed at solution of the acute shortage of innovative educational materials, designed to develop research skills and research competence in the prospective elementary school teachers. The program of research competence development should be used during the courses development in pedagogical universities and in professional development (certification) of teachers.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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