Research Competence of Pre-Service Teachers: A Systematic Literature Review

Miha Matjašič[*] ⓘD
University of Ljubljana, SLOVENIA

Janez Vogrinc ⓘD
University of Ljubljana, SLOVENIA

Abstract: The importance of research competence in pre-service teacher education has been highlighted in many studies, but concerns over the lack and inconsistency of definition, measurement, and development of research competence still exist. This poses a challenge for pre-service education programmes to provide quality education to pre-service teachers in this area. Through a systematic literature review it was found that there is a gap in the existing literature regarding the definition of research competence in pre-service teacher education, as there seems to be no consensus on the definition. There is, however, an agreement that the development of research competence is an important part of study programmes, as it contributes to higher quality education of pre-service teachers. Addressing this, the review proposes a concise definition of research competence as a multifaceted construct that includes critical thinking, self-directed learning, and organizational skills essential for effective research. The review also highlighted a lack of consensus on the most appropriate frameworks and tools to use in measuring research competence in pre-service teachers, with studies using various frameworks and tools that differ in terms of research methods, instruments and sample characteristics. The results suggest that there is a need for greater attention to be paid to the definition and measurement of research competence, as well as its development within pre-service teacher education programmes.

Keywords: *Development of research competence, educational research, measurement of research competence, pre-service teachers, research competence.*

Introduction

In the current educational landscape, there is a growing demand for teachers who are equipped with the knowledge, skills and competence required to support student learning and development. To meet this demand, pre-service teacher education programmes play a crucial role in preparing future teachers with the necessary knowledge, skills and competence to become effective and reflective educators (Saqipi & Vogrinc, 2020; Štemberger, 2020; Van Katwijk et al., 2023). Competencies are a set of related abilities, responsibilities, insights and professional knowledge that enable a teacher to operate effectively in the profession. As well as being the basis of all professional work behaviour, they are of key importance for the successful performance of the profession (Blaskova et al., 2015; Saqipi & Vogrinc, 2016; Thiem et al., 2023).

If a teacher wants to successfully teach students and help them to develop the competences that are important in contemporary society, s/he must first acquire these competences him/herself (Belasić & Meserko, 2020). Teaching in today's world requires the integration of research elements into all aspects of teacher education, which calls for an inquiry-oriented approach that reflects the conceptual level of research-based teacher education (Krokfors et al., 2011).

In recent years, there has been growing interest in the concept of research-based teaching and its potential to enhance the learning experience of pre-service teachers (Bayrak Özmutlu, 2022; Krokfors et al., 2011). Research-based teaching integrates research and evidence-based practices into the curriculum in order to equip pre-service teachers with the knowledge and skills needed to be effective educators who can use research to inform their teaching practices (Bayrak Özmutlu, 2022). Winch et al. (2015) pointed out that research-based teaching can enrich teachers' professional knowledge, while Admiraal et al. (2014) argued that research-based teaching is a way to bridge the gap between teaching theory and practice, which refers to the implementation of research results in practice, using practice as a source of research problems, and collaboration between researchers and practitioners. These findings have been complemented

[*] **Corresponding author:**
Miha Matjašič, University of Ljubljana, Faculty of Education, Kardeljeva ploščad 16, 1000 Ljubljana, Slovenia. ✉ miha.matjasic@pef.uni-lj.si

by various studies (Bayrak Özmutlu, 2022; Robertson & Blackler, 2006; Visser-Wijnveen et al., 2012) showing that students perceive both benefits and challenges when links between research and teaching are emphasised. The perceived benefits include increased motivation and interest in the subject, due to teacher enthusiasm and greater credibility. Furthermore, teaching is perceived as more challenging and intellectually stimulating, particularly when research assignments are given to students, while interactions with the teacher and researchers are especially valued. A research-based approach not only supports the development of pre-service teachers' research skills, but also contributes to the development of their research competence (Bayrak Özmutlu, 2022; Bendtsen et al., 2021). A study undertaken by Thiem et al. (2023) showed that engagement in research-based teaching significantly increased students' self-rated research competence.

Many studies argue that research competence is a crucial skill for pre-service teachers to develop in order to be able to support student learning and development (Bayrak Özmutlu, 2022; Gómez-Núñez et al., 2023; Štemberger, 2020; Thiem et al., 2023). As education continues to evolve, teachers are expected to incorporate evidence-based practices into their teaching and decision-making processes. Thus, many studies point out that pre-service teacher education must equip pre-service teachers with research competence in order to strengthen the quality of their teaching (Magnaye, 2022; Saqipi & Vogrinc, 2016; Štemberger, 2020). However, while research competence is generally acknowledged as an essential skill set in academia, there is surprising variability in how it is defined across different studies. Some studies equate research literacy with research competence while some studies do not explicitly define what constitutes research competence, leaving it as an assumed or implied skill set. There are also different views in the existing literature on what pre-service teachers should know about research, whether more emphasis should be placed on research design, statistical data processing, action research, qualitative analysis, etc. Moreover, within certain educational circles, there persists a view that it is enough for teachers to know how to read and understand research reports written by "real" researchers, that it is enough for them to know how to implement researchers' recommendations into their pedagogical practise. On the other hand, among academic researchers and some teacher training institutions there is a growing realisation that school reforms in which teachers merely implement the decisions of others are already doomed to failure. Thus if the definition of research competence is not clear, we cannot think about how to develop research competence in pedagogical programmes and how to measure students' progress in developing research competence. This ambiguity also makes it difficult to assess, measure and compare levels of research competence across different educational settings, while also presenting challenges for educators, particularly those responsible for training pre-service teachers in research methodologies. The lack of clarity creates difficulties in identifying the most appropriate frameworks and methodologies for assessment, thus creating a challenge for teacher educators who seek to prepare pre-service teachers for conducting research that contributes to the advancement of knowledge in their field.

In order to demonstrate the prevalence of the issues outlined above, we conducted a systematic literature review. By synthesising the findings of the available literature, this review will contribute to a better understanding of the current state of research on research competence in pre-service teachers' education, identify gaps and limitations in the existing literature, and provide insights into how pre-service teacher education programmes can best support the development of research competence in pre-service teachers. The findings of this review will be of interest to educators, researchers and policy makers who are committed to improving the quality of teacher education and, ultimately, the effectiveness of teaching and learning in schools. This will be of particular interest to universities and educators, as well as policymakers. In this regard, a study by Štemberger (2020) has demonstrated that there is a compelling need for further research and policy development aimed at standardising and enhancing the cultivation of research competence among education programmes for pre-service teachers.

Research Questions

Due to the growing importance of developing the research competence of pre-service teachers, we conducted a systematic literature review of existing papers dealing with this topic. Specifically, we aimed to answer the following research questions (RQ):

RQ1: What is the definition of research competence in the context of pre-service teacher education?

RQ2: What is the methodology used to measure research competence in pre-service teachers (sample, methods, instruments, analysis)?

RQ3: What approaches do researchers propose in their scientific works for the development of research competence in pre-service teachers?

Methodology

Search Strategy

The international standard for reporting results of systematic reviews and meta-analyses (PRISMA) (Page et al., 2021) was used to guide the methodology of our systematic review. A systematic literature search was conducted using the Digital Library of the University of Ljubljana, which enables access to more than 20,000 paid electronic journals and more than 170,000 paid electronic books for a wide range of databases including Elsevier ScienceDirect, SpringerLink, Wiley,

JSTOR, Emerald, Sage, EBSCOhost, Taylor & Francis, Oxford University Press, Web of Science, and Scopus. These databases were selected for their extensive coverage of publications relevant to our research topic. The search strategy utilized a comprehensive set of key terms combined with Boolean operators to maximize the retrieval of relevant literature. Our search string was: ("research competence" AND ("pre-service teachers" OR "initial teacher education" OR "future teachers" OR "students in education")) OR ("developing research competence" AND ("pre-service teacher education" OR "initial teacher education")) OR ("research-based teaching" AND "research competence") OR ("research-based learning" AND "research competence") OR ("research competence" AND "teachers") OR ("research competences" AND "educational studies") OR ("research competence" AND "humanities").

Eligibility Criteria

We reviewed all of the scientific papers in English published on or before 5 September 2023 (with no lower limit) that met the inclusion criteria shown in Table 1. It should be noted that the focus of the present paper is limited to scientific papers, books and book chapters.

Table 1. Eligibility Criteria of Scientific Papers, Books, and Book Chapters

Inclusion criteria	Exclusion criteria
Works that focus on (pre-service) teachers' research competence.	Works that do not focus on (pre-service) teachers' research competence.
Works that investigate the development, implementation or assessment of research competence among (pre-service) teachers.	Works that do not investigate the development, implementation or assessment of research competence among (pre-service) teachers.
Works with full text available in English.	Works without the full text available in English.

Sample and Data Collection

Through database searches based on the key search terms, 36 articles were identified dealing with the research competence of pre-service teachers (or future teachers or students enrolled in initial teacher education or in-service teachers). The available abstracts of these articles were screened using the inclusion criteria. A total of 14 abstracts were rejected because they failed to meet at least one of the criteria. For the 22 abstracts that met the inclusion criteria, full manuscripts were retrieved for screening and all of them proved to be eligible for systematic review (see Figure 1). In order to further ensure the quality and rigor of our systematic literature review (apart from using PRISMA), two reviewers extracted and screened the articles independently to minimise bias. Feedback was also sought from experts in the field.
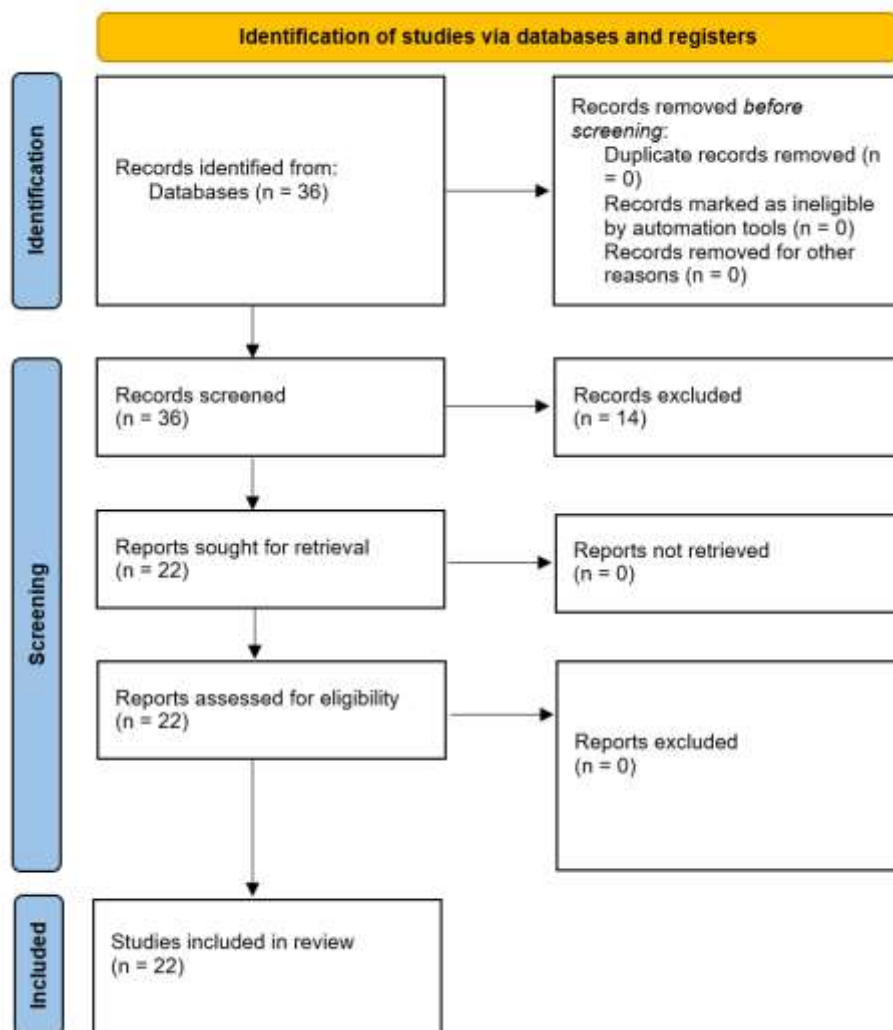
Figure 1. PRISMA Flow Diagram for the Included Scientific Papers

Findings/Results

Overview of the Selected Articles

The systematic review thus included 22 scientific articles published between 2015 and 2023. The full references and characteristics of the included articles are presented in Table 2. For reasons of readability, a numeric study ID was assigned to each of the remaining 22 articles. In the present article (tables and text), references are made via the ID rather than via in-text-citations.

As is evident from Table 2, the articles cover a range of topics related to the development of research competence in different contexts, including pre-service teacher education, mathematics education, biology education and sustainability education, as well as Science, Technology, Engineering, Arts and Math's (STEAM) education. Some of the articles explore the challenges of introducing research-based approaches in teacher education, while others investigate the effectiveness of various teaching methodologies for developing research competence. Additionally, several articles examine the relationship between research competence and other competences, such as pedagogical competence. Overall, the studies provide insights into the development of research competence in different educational settings and offer recommendations for improving research education.

Table 2. Selected Studies

ID	Author	Title	Research focus
1	Ivanenko et al. (2015)	Basic Components of Developing Teachers' Research Competence as a Condition to Improve Their Competitiveness	To determine the basic components of developing the research competence of vocational education institutions teachers.
2	Yarullin et al. (2015)	The Research Competence Development of Students Trained In Mathematical Direction	To develop a model of the research competence development of students trained in the mathematical direction in the process of studying specific mathematical disciplines.
3	Syzdykbayeva et al. (2015)	Formation of Research Competence of the Future Elementary School Teachers—In the Process of Professional Training	To investigate the development of research competence in future elementary school teachers during their professional training.
4	Saqipi and Vogrinc (2016)	Developing research competence in pre-service teacher education	To identify the current status and challenges in introducing teacher practitioner research in pre-service education and the role of the wider context in transitioning towards research-based teacher education in Slovenia and Kosovo.
5	Lambrechts and Van Petegem (2016)	The interrelations between competences for sustainable development and research competences	To explore how competences for sustainable development and research interrelate within the context of competence-based higher education, with a specific focus on strengthening research competences for sustainability.
6	Albareda-Tiana et al. (2018)	Holistic Approaches to Develop Sustainability and Research Competencies in Pre-Service Teacher Training	To explore which teaching methodologies are suitable for the development of competencies in sustainability and research in higher education.
7	Skurikhina et al. (2018)	Forming Research Competence and Engineering Thinking of School Students by Means of Educational Robotics	To study the didactic potential of robotics for school students' research competence formation and to offer a methodical approach to the organisation of classes in robotics on the basis of research tasks and research projects.
8	Agud and Ion (2019)	Research-Based Learning in Initial Teacher Education in Catalonia	To investigate the development of research competence in initial teacher education and to present ways to reshape teacher education using a research-based approach.
9	Koletvinova and Bichurina (2019)	Development of Research Competence of Future Teachers in The Process of Their Professional Training.	To develop a multifunctional, theoretically grounded and practice-oriented paradigm for the development of students' professional research competence and its approbation.
10	Štemberger (2020)	Educational Research Within the Curricula of Initial Teacher Education: The Case of Slovenia.	To provide a systematic insight into the research components within initial teacher education programmes in Slovenia.
11	Amirova et al. (2020)	Creative and Research Competence as a Factor of Professional Training of Future Teachers: Perspective of Learning Technology	To provide a comprehensive review of creative and research competence as a factor of professional training of future teachers according to the perspective of learning technology.
12	Anisimova et al. (2020)	Formation of Design and Research Competencies in Future Teachers in the Framework of STEAM Education	To determine the ways and means of forming future teachers' research competencies in the framework of STEAM education.

Table 2. Continued

ID	Author	Title	Research focus
13	Leonard and Wibawa (2020)	Development of Teacher Research Competency Training System in Indonesia: A Need Analysis	To research the principles of basic needs in the development of a training system to improve teachers' research competence.
14	Toquero (2021)	"Real-world:" preservice teachers' research competence and research difficulties in action research	To provide an analysis of a teacher education programme focused on the development of research competence in pre-service teachers, the difficulties pre-service teachers encounter in conducting action research, and the need to provide them with realistic research opportunities.
15	Çelebi (2021)	Investigation of the Attitudes and Competencies of Teachers in Project Schools Towards Scientific Research in a Developing Country	To determine the attitudes and competence levels of teachers in project schools who are expected to be qualified for scientific research, and to develop suggestions for training qualified school teachers.
16	Salmento et al. (2021)	Understanding Teacher Education Students' Research Competence Through Their Conceptions of Theory	To increase the understanding of teacher education students' research competence by exploring how they understand one of the most fundamental scientific concepts: the concept of theory.
17	Magnaye (2022)	Pedagogical and Research Competence of the Pre-service Teachers	To assess and determine the relationship between the pedagogical and research competence of pre-service teachers in pedagogy and research.
18	Tuchyna and Kamynin (2022)	Developing Research Competence of Pre-Service EFL Teachers	To highlight the features of the process of developing students' research competence.
19	Ciraso-Calí et al. (2022)	The Research Competence: Acquisition and Development Among Undergraduates in Education Sciences	To identify and map learning outcomes related to research competences declared in syllabi, to gather students' perceptions about the development of these learning outcomes, and to explore guidelines to foster research competences among these undergraduates through the Delphi panel technique.
20	Bayrak Özmutlu (2022)	Views of pre-service teachers on the research-based teacher education approach	To investigate the views of pre-service teachers about (a) the outcomes provided by the research methods course, (b) the reasons for teachers to have research competencies, and (c) the professional function of scientific studies.
21	Gómez-Núñez et al. (2023)	Research Competence Development in Higher Education Through a Virtual Educational Escape Room	To analyse the application of an educational escape room for the development of research competence in students of the Primary Education Degree.
22	Gussen et al. (2023)	Supporting pre-service teachers in developing research competence	To investigate how different types of learning environments (restrictive structured and non-restrictive structured) impact the development of research competence in pre-service biology teachers.

Definition of Research Competence

From Table 3, we can see that in Article [1], research competence encompasses several components. The motivational-value component involves motivation, clear goals and value systems in relation to research activities. The methodology-reflective component emphasises the ability to use teaching reflection, identify problems, form hypotheses and possess analysis skills. The operational-activity component focuses on practical skills such as conducting research, collaboration, data analysis and applying research results. Lastly, the emotional-volitional component involves exhibiting high moral qualities, perseverance, continuous self-improvement and striving for high-quality outcomes. Together, these components form a comprehensive understanding of research competence. Article [2] highlights the fact that research competence consists of knowledge, skills, habits and the capacity for independent cognitive activity. Article [3] emphasises the ability to understand scientific information, pursue independent search and organise professional activities in a modern scientific platform, while Article [5] defines research competence as the ability to analyse a given topic or subject in a structured, research-based manner, following systematic steps in a research project. Article [6] involves several aspects, including a well-elaborated theoretical framework, a proper research methodology, effective written communication and attention to formal aspects. Article [7] views research competence in students as their ability and willingness to organise and conduct effective educational research, as well as to continuously educate and improve themselves. Additionally, research competence includes integrating research actions in a coherent manner and understanding the progression from routine tasks to more creative and constructive activities. Article [9] states that research competence involves theoretical knowledge and the possession of the necessary and sufficient competence components of research activities in terms of modern educational requirements. Article [14] asserts that research competence is acquired by engaging in relevant research experiences, in conjunction with the development of knowledge as well as behavioural and affective research-related skills. Article [15] highlights the importance of the individual's belief in conducting research, while Article [16] defines research competence as the research skills of a teacher or student. Articles [17] and [18] highlight the importance of being able to search for information and apply the results of the available research in one's practice. Article [21] provides a comprehensive definition that includes knowledge, skills, attitudes and learning strategies as components that facilitate efficient research processes in different domains, while Article [22] states that research competence is not defined as a single, clear-cut term, but encompasses a range of knowledge, attitudes and behaviours that are essential for successful research. Eight articles [4, 8, 10, 11, 12, 13, 19, 20] mentioned research competence in their respective contexts, but did not provide a clear and concise definition of what it entails.

Table 3. The Definition of Research Competence in the Selected Studies

ID	Definition of research competence
1	Involves the following components: motivational value, methodology-reflective, operational-activity, emotional-volitional.
2	The body of knowledge, skills and habits, as well as the ability for independent cognitive activity. The content of the research competence represents the body of four interconnected components: cognitive, motivation-goal, activity-evaluation and communicative.
3	The ability to understand the flow of scientific information, to pursue an independent search for the necessary information, and to organise professional activities, seen not just as a set of skills or knowledge, but also as a positive attitude or motivation towards engaging in research activities. The term "research competence" is considered mainly through the category of "attitude" and understood as the valuable-motivational attitude of the teacher to research activities.
4	Not clearly stated.
5	A competence that enables students to analyses a given topic or subject in a structured, research-based way, often following the systematic steps in a research project. This definition was cited from Verburgh (2013).
6	Not clearly stated. Based on the information provided, the definition seems to involve several aspects, including: a well-elaborated theoretical framework or introduction with clear objectives; correct research methodology; justification of results and appropriate use of charts; effective written communication; accurate and appropriate use of bibliography and citations; and attention to formal aspects such as figures and margins.
7	The ability and readiness to organise and conduct effective educational research (and further research work), the ability and readiness to engage in self-education and self-improvement throughout life, the integration of research actions into a coherent whole, defining the dynamics of the transition from performing to creative and constructive activities.

Table 3. Continued

ID	Definition of research competence
8	Not clearly stated.
9	A set of theoretical knowledge allowing the derivation of new knowledge about the subject of research based on independent study of scientific and educational material and possession of the necessary and sufficient competence components of research activities in terms of the requirements of modern education.
10	Not clearly stated.
11	Not clearly stated.
12	Not clearly stated.
13	Not clearly stated.
14	The whole complex of educational competencies directly connected with thought, search, logic and the creative processes of students' mastering knowledge. This definition was cited from Yarullin et al. (2015).
15	The individual's belief in conducting research. This definition was cited from Bard et al. (2000).
16	Research skills.
17	The ability to reflect on teaching practices, use research findings to improve educational materials, integrate knowledge from various professional fields, identify problems, formulate objectives, create hypotheses, conduct experiments, evaluate and synthesise research and take risks. This definition was cited from Ivanenko et al. (2015).
18	A general competence needed by specialists of any profession. The authors also cite Andriessen (2014), who defines research competence as the abilities of a teacher to adopt a stance of enquiry and to organise his/her work according to it; the ability of a teacher to search for information and apply the results of the available research in his/her teaching practice; and the ability to independently plan and carry out practical research.
19	Not clearly stated.
20	Not clearly stated.
21	A set of knowledge, skills, attitudes and learning strategies that allow the development of efficient and effective research processes in different educational or scientific fields.
22	A set of knowledge, attitudes and behaviours that are essential for successful research, including skills such as critical thinking, ethical reasoning and the ability to effectively communicate research findings.

Methodologies

We also investigated the methodologies used in measuring research competence in pre-service teachers. Specifically, we focused on the sample (size), research methods, instruments and analysis employed in articles to gain a comprehensive understanding of the current state (see Table 4).

Summarising the findings from Table 4, we can observe that the sample size and participants varied greatly. Some articles [1, 3, 7, 11] did not report the sample size, while others reported a sample size ranging from 6 experts to 336 teachers. The type of participants also varied, as articles included pre-service teachers (ranging from 23 to 240), in-service teachers (21), and education and learning experts (6). The articles also focused on different groups, such as students in specific training programmes (Physics, Mathematics and Computer Sciences, Applied Mathematics and Informatics, Primary Education, Bachelor of Secondary Education, etc.), or all students in pre-service education programmes at different levels (bachelor's and master's).

Out of the 22 articles, 8 used a quantitative method [2, 6, 9, 12, 15, 16, 17, 22], 7 used a qualitative method [4, 5, 11, 13, 14, 18, 20], 4 used mixed methods [8, 10, 19, 21] and 2 used a theoretical (literature review) method of collecting the data [1, 3]. Moreover, a variety of research instruments were used to measure research competence, such as surveys, questionnaires, interviews, documents and Delphi panel techniques, indicating that some measured only perceived research competence, while others measured actual research competence, and still others measured both. The studies also seem to have been conducted in various locations and educational institutions, and many of them used basic forms of analysis such as descriptive or comparative analysis.

It is also evident that some of the studies broadly assessed research competence [2, which looked at seven abilities], while others had a narrower focus, such as the assessment of written presentation of research projects [6] or the analysis of paper proposals [14]. On the other hand, there were several studies [4, 5, 7, 9, 13, 16 18, 20] that did not specify the exact details or results of their research competence measurements, indicating potential gaps in the literature.

Table 4. Methodology for Measuring Research Competence

ID	Sample	Method	Instruments	Analysis
1	Not reported.		Did not measure research competence.	
2	60 students of the specified training directions: Physics, Mathematics and Computer Sciences, and Applied Mathematics and Informatics.	Quantitative (experiment).	Items measuring seven abilities, including increasing professional competence, formulating scientific problems, planning and programming educational research, applying techniques from adjacent fields of knowledge, interpreting and generalising research results, and presenting research results in various forms. Assessment of items on a three-point scale: perfect mastery (3), mastery (2), and poorly expressed mastery (1).	Descriptive analysis. Comparative analysis.
3	Not reported.		Did not measure research competence.	
4	57 pre-service teachers from the University of Ljubljana and 53 pre-service teachers from the University of Prishtina enrolled in a master's study programme course in research work.	Qualitative.	Open-ended survey questionnaire. Questions not provided.	Content analysis.
5	14 study programmes of the Leuven University College and four different focus groups from each of four departments (researchers, teachers, policy members).	Qualitative.	Study programme curricula. Questions for focus groups. Questions not provided.	Document analysis. Content analysis.
6	23 students of the Degree in Primary Education of the Faculty of Education at the Universitat Internacional de Catalunya	Quantitative.	Instrument for the assessment of the research competence of the students' research projects on a scale from 0 to 2, where 0–0.5 = lacks command of the competence; 0.5–1 = poor command (only knows); 1–1.5 = good command (knows how) and 1.5–2 = very good command (shows how and does). Instrument provided.	Descriptive analysis. Bivariate Analysis.

Table 4. Continued

ID	Sample	Method	Instruments	Analysis
7	Not reported.		Not clearly stated.	
8	113 students of the Primary Teacher Education Degree were studied. The sample size calculation considering a 95% confidence level for finite populations (p and q = 0.5) indicated that the margin of error was ±6.72	Mixed Method.	Study programme curricula. Student Perception Research Integration Questionnaire (SPRIQ). This instrument is a tool with 40 items scored on a five-point Likert scale. The questionnaire consists of three constructs: 'research integration', 'quality of the course', and 'beliefs about research integration'. Questions provided.	Document analysis. Descriptive analysis. Comparative analysis.
9	80 first-year students of the Institute of Psychology and Education, Kazan (Volga Region) Federal University.	Quantitative (experiment, survey research).	Survey questionnaire assessing the degree of interest in the problem of research, the level of knowledge of the topic, and the ability to apply research skills in professional activities. Questions provided.	Descriptive analysis. Comparative analysis.
10	19 bachelor pre-service teacher education programmes and 78 master's pre-service teacher education programmes.	Mixed Method.	Documents (initial teacher education programme curricula and syllabi of educational research courses).	Document analysis. Descriptive analysis. Comparative analysis.
11	Not reported.	Qualitative.	Documents (books and articles published in scientific journals) containing information about teacher training, education and supervision systems, and creative and research competencies of future teachers.	Document analysis.
12	80 students enrolled in final and penultimate undergraduate courses, and 15 students in the first course at the Faculty of Mathematics and Natural Sciences and the Faculty of Engineering and Technology of the Yelabuga Institute of Kazan Federal University. The survey also included 21 in-service teachers of mathematics and physics as a comparison group.	Quantitative.	Survey questionnaire consisting of eight questions. Questions provided.	Descriptive analysis.

Table 4. Continued

ID	Sample	Method	Instruments	Analysis
13	6 education and learning experts.	Qualitative.	Interviews designed to provide the information required to set general and specific instructional objectives, training regarding important principles for teachers, materials that need to be given, and provisions on the trainees' criteria. Questions not provided.	Need analysis.
14	133 randomly selected pre-service teachers taking the Elementary Education programme at the Mindanao State University-General Santos City.	Qualitative.	Documents (paper proposals and open-ended questions).	Document analysis. Thematic analysis following six phases (familiarising data, generating initial codes, searching for themes, reviewing themes, defining, and main themes, producing report). Questions provided.
15	336 teachers of 21 project high schools. The schools were determined by using the stratified sampling method.	Quantitative.	Survey questionnaire consisting of 43 items. The questionnaire included five sub-dimensions: problem definition (6 items), literature review (5 items), method (9 items), findings and interpretation (6 items), and reporting (7 items). Teachers were asked to express the level of the competencies in question as full (3), slightly (2) and none (1). Questions not provided.	Descriptive analysis. Comparative analysis.
16	179 Finnish teacher education students: 114 first or second year students, and 65 fourth or fifth year students.	Quantitative.	Survey questionnaire consisting of background information and an open-ended question. Questions provided.	Descriptive analysis. Comparative analysis.

Table 4. Continued

ID	Sample	Method	Instruments	Analysis
17	130 Bachelor of Secondary Education pre-service teachers of Northwest Samar State University, school year 2018–2019.	Quantitative.	Survey questionnaire with rating scale of 1 to 5: 1 – very incompetent, 5 – very competent. Questions not provided.	Descriptive analysis. Comparative analysis. Multivariate Analysis
18	20 students studying for a bachelor's and master's degree at the Department of Foreign Philology of H. S. Skovoroda Kharkiv National Pedagogical University.	Qualitative.	Observations and structured interviews, which were recorded, transcribed and analysed (critical analysis). Questions provided.	Content analysis.
19	154 undergraduate students of two bachelor's degrees in Education Sciences (Social Education and Pedagogy) of the Universitat Autònoma de Barcelona (Spain), and teaching syllabi of each degree from the first to the fourth year.	Mixed Method.	Documents (teaching syllabi of each degree from the first to the fourth year). Survey questionnaire used from other researchers, comprising 36 items across 5 dimensions. Participants rated the items on a scale from 0 to 4. Questions not provided but the reference to the questionnaire was given.	Content analysis. Descriptive analysis. Comparative analysis.
20	110 pre-service teachers from a state university in Turkey who attended a research education course designed on the basis of the research-based teacher education approach for 14 weeks.	Qualitative	Interviews comprising open-ended questions measuring views about the outcomes provided by research education, the reasons for teachers to have research competencies, and the professional function of scientific studies. Questions not provided.	Content analysis.
21	22 students of the Primary Education Degree in a private Spanish university chosen through non-probabilistic sampling.	Mixed Method	Observations during class time. Survey questionnaire comprising ten items assessed on a ten-point interval scale, in which 1 was the lowest and 10 the highest score. Questions provided.	Content analysis. Descriptive analysis. Comparative analysis.
22	108 pre-service biology teachers attending a master's programme at the German University (56 in a non-restrictive structured group, 52 in a restrictive structured group)	Quantitative (longitudinal study with pretest, mid-term, post-test).	Survey questionnaire with two rating scales from 1 to 5. Questions provided.	Descriptive analysis. Comparative analysis. Multivariate Analysis

Development of Research Competence

The analysed articles proposed various approaches to the development of research competence. From Table 5, it is evident that one common suggestion emerging from many of the articles [2, 3, 4, 8, 10, 12, 18, 19, 20, 22] is an emphasis on integrating research into the educational framework. This could be achieved by incorporating research tasks, assimilating students into the fabric of research activities, and embedding research-based education in teacher education programmes. Additionally, many of the articles [1, 8, 10, 12, 14, 18, 19] emphasise the importance of practical experience. The emphasis is on concrete experiences such as diving into project-based learning, embracing action research, or actively participating in research projects and guiding programmes. Moreover, there is an emphasis on collaboration in various forms, whether it is peer collaboration, the formation of educational-research communities, or fostering collaborative learning and mentorship [3, 4, 18 19]. In the modern educational landscape, technology and innovation have also found their rightful place, and several of the articles [1, 7, 11, 21] highlight their significance in cultivating research competence. This is manifest in diverse suggestions, such as leveraging robotics, seamlessly integrating technology into curricula, and supporting innovative teaching methods. On the other hand, professional development is identified as a crucial tool, with several of the articles [1, 11, 14, 17] accentuating the importance of regular training, seminars, workshops and conferences. A focus on enhancing teacher education is also evident. The literature often circles back to specific proposals, such as weaving research tasks into pre-service teacher education, strategically aligning student projects with broader school initiatives, laying down clear curriculum guidelines, and orchestrating regular research-centric workshops. However, it is worth noting that some of the articles [5, 6, 9, 13, 15, 16] remain ambiguous, with no clear direction on their stance regarding research competence. This suggests potential gaps or a need for greater clarity in the literature.

Table 5. The Proposed Development of Research Competence in the Selected Articles

ID	Development of research competence
1	Developing new courses, lab work, seminar programmes and using modern tech.
	Engaging in research projects, guiding programmes, participating in conferences, publishing.
	Organising events, guiding student works for competitions.
	Taking on responsibilities, participating in committees and councils.
	Assessing discipline, responsibilities, interactions.
2	Incorporating research tasks into students' education.
3	Integrating students' subjective positions into research activities, facilitating independent research work, and fostering an educational-research community involving students, university teachers and school teachers.
4	Incorporating research tasks and peer collaboration into pre-service teachers education.
5	Not clearly stated.
6	Not clearly stated.
7	The use of robotics in education and engineering.
8	Integration of action research.
	Aligning student projects with ongoing research or school initiatives.
	Establishing national curriculum guidelines for teacher education.
9	Not clearly stated.
10	Inclusion of educational research courses in pre-service teachers' education. Greater involvement of students in research projects.
11	Training students to tackle creative and research tasks with an uncertain outcome.
	Integrating technology into education.
	Regular training opportunities for teachers.
12	Project-based learning.
	Incorporating innovative teaching methods.
13	Not clearly stated.
14	Integration of a research course.
	Integration of action research.
	Organising regular research workshops for research supervision of pre-service teachers.
15	Not clearly stated.
16	Not clearly stated.
17	Implementation of training, seminars, workshops and conferences.

Table 5. Continued

ID	Development of research competence
18	Integration of research-related activities and projects into the curriculum. Collaboration between the dean's office, teaching staff and student scientific societies. Project-based learning. Integration of action research. Collaborative learning and mentorship. Reflective practice.
19	Integration of action research. Collaborative efforts among faculty members from various fields. Integrating scientific research.
20	Integration of research-based education into teacher preparation programmes. Incorporating research methods and practices into the curriculum, exposing pre-service teachers to research literature, and providing opportunities for them to engage in research activities. Incorporating research projects and courses into teacher education curricula.
21	Integration of gamification through the development of a virtual escape room.
22	Changes in curriculum design, assessment methods and the practical application of research skills.

Conclusion

The structure of the conclusion is guided by our four research questions. By structuring our conclusion around these questions, we aim to provide a coherent and focused synthesis of our findings, shedding light on the complexities and nuances that our research has uncovered in each area.

What Is the Definition of Research Competence in the Context of Pre-Service Teacher Education?

From the analysed studies, it is evident that there is a lack of consensus among scholars and researchers regarding a universally accepted definition of research competence. Additionally, a considerable number of the studies failed to provide a clear and concise definition of this construct, and some even mixed the concepts of research competence and research literacy. This inconsistency in defining research competence can lead to confusion and difficulties in interpreting and synthesising research findings. However, there are several common themes that emerge from the various definitions. Research competence is generally understood to involve a combination of knowledge, skills and attitudes related to the ability to engage in independent cognitive activity and pursue research-related goals. Additionally, we define research competence as the ability to analyse a given topic or subject in a structured, research-based way, often following the systematic steps in a research project. Our definition also underscores the importance of effective communication and the use of appropriate research methodologies, as well as the ability to reflect on one's teaching practices and use research findings to improve educational materials. Overall, our definition of research competence suggest that research competence is a multifaceted and complex construct that encompasses a range of knowledge, skills, attitudes and behaviours necessary for effective research practice, including critical thinking, self-directed learning and the ability to organise and conduct research activities. However, more research is needed to better understand the complexities of research competence.

What Is the Methodology Used to Measure Research Competence in Pre-Service Teachers (Sample, Methods, Instruments, Analysis)?

It appears that there is no clear consensus on the methodology for measuring research competence among pre-service teachers. While some studies did not report the sample size, others had a wide range, from 6 experts to 336 teachers, and only in one study [8] provided a justification for the sample size for quantitative research. Moreover, the articles analysed included a diverse range of participants, from pre-service and in-service teachers to education and learning experts, and focused on a variety of groups, such as students in specific training programmes or all of the students in teacher education programmes at different levels. Including diverse participants may give rise to several potential gaps, including issues with comparability across studies, methodological inconsistencies, lack of depth in understanding specific groups, context-specific findings that limit generalisability, etc. It appears that quantitative methods, particularly surveys, are the most commonly employed research approach, closely followed by qualitative methods, with document analysis being a notable technique. The choice of method likely depends on the research question, the type of data being collected and the goals of the study. The diverse range of instruments and analytical methods used in the studies highlights the inherent complexity of measuring research competence. This diversity underscores the necessity for employing multiple approaches to fully capture the multi-faceted nature of research competence. Many of the articles rely on basic analytical techniques such as descriptive or comparative analysis, but these methods may limit the depth of the insights gained. Conversely, several articles employ document or content analysis, which allows for an exploration of existing materials and texts. Although this offers a valuable alternative perspective, it may not capture the dynamic nuances of human interactions and behaviours. It is also worth noting that some of the studies did not provide sufficient information on the

specific instruments or questions used to measure research competence, thus limiting the interpretability and replicability of their findings. Overall, the findings from analysed articles suggest that there is a lack of consensus in the literature on how to measure and assess research competence in pre-service teachers. We believe that the use of a mixed-method approach (and a standardised set of instruments) may provide a more comprehensive understanding of the development and acquisition of research competence among pre-service teachers. Firstly, different research methods can provide different types of data and insights into the phenomenon being studied (perceived vs. actual research competence). For example, using qualitative methods such as interviews and focus groups can help researchers understand the subjective experiences and perspectives of pre-service teachers, while quantitative methods such as surveys can provide more objective and generalisable data. Secondly, using mixed methods can help researchers triangulate their findings, enabling them to cross-validate and verify their results using different sources of data. This can help increase the validity and reliability of the research, as well as providing a more nuanced and detailed understanding of the phenomenon being studied. Lastly, using a variety of methods can also help address the limitations and weaknesses of each individual method (Creswell & Plano Clark, 2017).

What Approaches Do Researchers Propose in Their Scientific Works for the Development of Research Competence in Pre-Service Teachers?

Various strategies and approaches are proposed to foster research competence. One overarching theme is the need to integrate research into the very fabric of education. This integration suggests a shift from traditional teaching methodologies to a more immersive approach where pre-service teachers are not mere consumers of knowledge but are actively involved in its creation and dissemination (e.g., action research). Theoretical knowledge, while essential, must be complemented with hands-on experience. This could be in the form of project-based learning or active participation in research projects, ensuring that pre-service teachers can apply what they learn in real-world contexts. A collaborative approach to research competence is another dominant theme. Collaboration is not limited to peer-to-peer interactions; it extends to the formation of educational-research communities and emphasises the value of mentorship. Such a collaborative framework can lead to the pooling of diverse ideas and the promotion of creativity and critical thinking among students. The role of technology in modern education is undeniable. The articles reflect this by underscoring the need to integrate technological advancements, such as robotics or a virtual education escape room, into teaching methodologies. Not only does this make the learning process more engaging, but it also ensures that pre-service teachers are equipped with skills relevant to the twenty-first century. The professional development of educators is another crucial aspect. Regular training, seminars and workshops can ensure that educators are kept up to date with the latest research methodologies and teaching strategies. This continuous learning can enhance the quality of teaching, which, in turn, can foster research competence among pre-service teachers. A significant emphasis is also placed on refining pre-service teacher education. Strategies such as incorporating research tasks in pre-service teacher education and aligning student projects with broader school initiatives can play a pivotal role in promoting research competence. Clearly laid-out curriculum guidelines can provide a roadmap for educators to ensure that research competence is an integral part of the learning process. However, it is essential to acknowledge the ambiguities present in some articles. The lack of clear direction in these articles might indicate gaps in the literature or suggest areas where more rigorous research is required. Moreover, it emphasises the need for continuous exploration in the field to ensure that strategies and methodologies evolve with changing educational landscapes. In conclusion, we argue that cultivating research competence requires a combination of collaboration, technological integration, practical experiences, professional development and a clear educational framework. As the world of education continues to evolve, so too must our approaches to fostering research competence, ensuring that pre-service teachers are well-equipped to navigate the complexities of the modern world.

Recommendations

There are several challenges that impede the effective integration and assessment of research competence in educational curricula. One of the most problematic issues is the lack of a clear, universally accepted definition of what constitutes research competence. In response to this identified need, our study contributes by defining research competence as a multifaceted and complex construct encompassing a broad range of knowledge, skills, attitudes, and behaviours crucial for effective research practice. This includes, but is not limited to, critical thinking, self-directed learning, and the organizational skills necessary to plan and conduct research activities. However, we also recognize that more research is needed to fully grasp the complexities and nuances of this vital skill set. Adding to the complexity is the absence of standardised tools and methods for measuring and assessing research competence. We strongly recommend the development and validation of such standardised tools (e.g., a comprehensive validated Likert-scale questionnaire covering various dimensions of research competence, research competency exams, etc.) in order to better gauge and enhance research competence in pre-service teachers. Moreover, there is a need for universities, educators and policymakers to re-evaluate the role of educational research in the everyday practice of pre-service teachers. Often, research is viewed as a separate, specialised skill rather than an integral component of effective teaching. This compartmentalised view limits the potential for research to inform and enhance teaching methodologies, curriculum design and student outcomes. A holistic approach that integrates research competence into the educational curriculum

could significantly benefit pre-service teachers (e.g., updated curriculum guidelines, partnerships with research institutions, etc.).

Limitations

The present literature review was limited by the range of articles, book chapters, or books available in the English language and published up to 5 September 2023. Future research may consider extending the temporal scope of the literature review as well as exploring works written in languages other than English. Furthermore, we did not conduct a meta-analysis, which would have synthesised the results from multiple studies in order to provide a more comprehensive understanding of research competence in pre-service teachers. This was beyond the scope of the current paper, so future research may consider undertaking a quantitative and qualitative meta-analysis of the articles.

Conflict of Interest

We have no known conflicts of interest to disclose.

Authorship Contribution Statement

Matjašič: Concept and design, drafting manuscript, data acquisition, data analysis, interpretation, critical revision of manuscript, writing. Vogrinc: Revision of manuscript, editing/reviewing, supervision, final approval.

References

Admiraal, W., Smit, B., & Zwart, R. (2014). Models and design principles for teacher research. *IB Journal of Teaching Practice*, *2*(1), 1-7. https://bit.ly/46DmjAJ

Agud, I., & Ion, G. (2019). Research-based learning in initial teacher education in Catalonia. *Center for Educational Policy Studies Journal*, *9*(2), 99-118. https://doi.org/10.26529/cepsj.564

Albareda-Tiana, S., Vidal-Raméntol, S., Pujol-Valls, M., & Fernández-Morilla, M. (2018). Holistic approaches to develop sustainability and research competencies in pre-service teacher training. *Sustainability*, *10*(10), Article 3698. https://doi.org/10.3390/su10103698

Amirova, A., Iskakovna, J. M., Zakaryanovna, T. G., Nurmakhanovna, Z. T., & Elmira, U. (2020). Creative and research competence as a factor of professional training of future teachers: Perspective of learning technology. *World Journal on Educational Technology*: *Current Issues*, *12*(4), 278-289. https://doi.org/10.18844/wjet.v12i4.5181

Andriessen, D. (2014). *Praktisch relevant én methodisch grondig? Dimensies van onderzoek in het HBO* [Practically relevant and methodically thorough? Dimensions of research in higher professional education]. Hogeschool van Utrecht. https://bit.ly/410ei7M

Anisimova, T. I., Sabirova, F. M., & Shatunova, O. V. (2020). Formation of design and research competencies in future teachers in the framework of STEAM education. *International Journal of Emerging Technologies in Learning*, *15*(2), 204-217. https://doi.org/10.3991/ijet.v15i02.11537

Bard, C. C., Bieschke, K. J., Herbert, J. T., & Eberz, A. B. (2000). Predicting research interest among rehabilitation counselling students and faculty. *Rehabilitation Counseling Bulletin*, *44*(1), 48-55. https://doi.org/10.1177/003435520004400107

Bayrak Özmutlu, E. (2022). Views of pre-service teachers on the research-based teacher education approach. *Tuning Journal for Higher Education*, *10*(1), 113-153. https://doi.org/10.18543/tjhe.2199

Belasić, I., & Meserko, V. (Eds.). (2020). *Dvig poklicnih kompetenc učiteljev v letih 2016-2022: Končno evalvacijsko poročilo o izvedbi programa* [The rise in the professional competence of teachers in the period 2016–2022: Final evaluation report on the implementation of the programme]. Centra RS za Poklicno Izobraževanje. https://bit.ly/46HkFhx

Bendtsen, M., Eklund, G., Forsman, F., & Pörn, M. (2021). Student teachers' experiences of action research-based projects: Two cases within pre-service teacher education in Finland. *Educational Action Research*, *29*(5), 707-721. https://doi.org/10.1080/09650792.2019.1684969

Blaskova, M., Blasko, R., Matuska, E., & Rosak-Szyrocka, J. (2015). Development of key competences of university teachers and managers. *Procedia - Social and Behavioral Sciences*, *182*, 187-196. https://doi.org/10.1016/j.sbspro.2015.04.755

Çelebi, M. (2021). Investigation of the attitudes and competencies of teachers in project schools towards scientific research in developing country. *Journal of Teacher Education and Educators*, *10*(1), 99-125. https://bit.ly/3Rs8Vvd

Ciraso-Calí, A., Martínez-Fernández, J. R., París-Mañas, G., Sánchez-Martí, A., & García-Ravidá, L. B. (2022). The research competence: Acquisition and development among undergraduates in education sciences. *Frontiers in Education*, *7*, Article 836165. https://doi.org/10.3389/feduc.2022.836165

Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research*. Sage publications.

Gómez-Núñez, M. I., Cano-Muñoz, M. Á., & Gómez-Núñez, J. A. (2023). *Research competence development in higher education through a virtual educational escape room*. In A. Santamaría Urbieta & E. Alcalde Peñalver. (Eds.), *Learning with escape rooms in higher education online environments* (pp. 114-133). IGI Global. https://doi.org/10.4018/978-1-6684-6081-8.ch006

Gussen, L., Schumacher, F., Großmann, N., González, L. F., Schlüter, K., & Großschedl, J. (2023). Supporting pre-service teachers in developing research competence. *Frontiers in Education*, *8*, Article 1197938. https://doi.org/10.3389/feduc.2023.1197938

Ivanenko, N. A., Mustafina, G. M., Sagitova, V. R., Akhmetzyanov, I. G., Khazratova, F. V., Salakhova, I. T., & Mokeyeva, E. V. (2015). Basic components of developing teachers' research competence as a condition to improve their competitiveness. *Review of European Studies*, *7*(4), 221-227. https://doi.org/10.5539/res.v7n4p221

Koletvinova, N. D., & Bichurina, S. U. (2019). Development of research competence of future teachers in the process of their professional training. In R. Valeeva (Ed.), *Proceedings of the V International Forum on Teacher Education (IFTE)* (pp. 353-362). Pensoft Publishers. https://doi.org/10.3897/ap.1.e0333

Krokfors, L., Kynäslahti, H., Stenberg, K., Toom, A., Maaranen, K., Jyrhämä, R., Byman, R., & Kansanen, P. (2011). Investigating Finnish teacher educators' views on research-based teacher education. *Teaching Education*, *22*(1), 1-13. https://doi.org/10.1080/10476210.2010.542559

Lambrechts, W., & Van Petegem, P. (2016). The interrelations between competences for sustainable development and research competences. *International Journal of Sustainability in Higher Education*, *17*(6), 776-795. https://doi.org/10.1108/IJSHE-03-2015-0060

Leonard, & Wibawa, B. (2020). Development of teacher research competency training system in Indonesia: A need analysis. *Universal Journal of Educational Research*, *8*(5), 2064-2070. https://doi.org/10.13189/ujer.2020.080544

Magnaye, L. J. (2022). Pedagogical and research competence of the pre-service teachers. *American Journal of Multidisciplinary Research and Innovation*, *1*(3), 81-88. https://doi.org/10.54536/ajmri.v1i3.391

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Research Methods and Reporting*, *372*, Article n71. https://doi.org/10.1136/bmj.n71

Robertson, J., & Blackler, G. (2006). Students' experiences in learning in a research environment. *Higher Education Research and Development*, *25*(3), 215-229. https://doi.org/10.1080/07294360600792889

Salmento, H., Murtonen, M., & Kiley, M. (2021). Understanding teacher education students' research competence through their conceptions of theory. *Frontiers in Education*, *6*, Article 763803. https://doi.org/10.3389/feduc.2021.763803

Saqipi, B., & Vogrinc, J. (2016). Developing research competence in pre-service teacher education. *Pedagoška Obzorja*, *31*(2), 101-117.

Saqipi, B., & Vogrinc, J. (2020). Editorial: The development of teacher research as a form of developing teacher pedagogical practice. *Center for Educational Policy Studies Journal, 10*(3), 5-9. https://doi.org/10.26529/cepsj.1003

Skurikhina, J. A., Valeeva, R. A., Khodakova, N. P., & Maystrovich, E. V. (2018). Forming research competence and engineering thinking of school students by means of educational robotics. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(12), Article em1639. https://doi.org/10.29333/ejmste/97827

Syzdykbayeva, A. D., Bainazarova, T. B., & Aitzhanova, E. N. (2015). Formation of research competence of the future elementary school teachers—In the process of professional training. *International Education Studies*, *8*(4), 200-209. https://doi.org/10.5539/ies.v8n4p200

Štemberger, T. (2020). Educational research within the curricula of initial teacher education: The case of Slovenia. *Center for Educational Policy Studies Journal*, *10*(3), 31-51. https://doi.org/10.26529/cepsj.871

Thiem, J., Preetz, R., & Haberstroh, S. (2023). How research-based learning affects students' self-rated research competences: Evidence from a longitudinal study across disciplines. *Studies in Higher Education*, *48*(7), 1039-1051. https://doi.org/10.1080/03075079.2023.2181326

Toquero, C. M. D. (2021). "Real-world:" Preservice teachers' research competence and research difficulties in action research. *Journal of Applied Research in Higher Education*, *13*(1), 126-148. https://doi.org/10.1108/JARHE-03-2019-0060

Tuchyna, N., & Kamynin, I. (2022). Developing research competence of pre-service EFL teachers. *Educational Challenges*, *27*(2), 216-227. https://doi.org/10.34142/2709-7986.2022.27.2.15

Van Katwijk, L., Jensen, E., & Van Veen, K. (2023). Pre-service teacher research: A way to future-proof teachers? *European Journal of Teacher Education*, *46*(3), 435-455. https://doi.org/10.1080/02619768.2021.1928070

Verburgh, A. (2013). *Research Integration in Higher Education: Prevalence and Relationship with Critical Thinking* [Doctoral dissertation, University of Leuven]. Ku Leuven. https://lirias.kuleuven.be/1940375?limo=0

Visser-Wijnveen, G. J., van Driel, J. H., van der Rijst, R. M., Visser, A., & Verloop, N. (2012). Relating academics' ways of integrating research and teaching to their students' perceptions. *Studies in Higher Education, 37*(2), 219-234. https://doi.org/10.1080/03075079.2010.536913

Winch, C., Oancea, A., & Orchard, J. (2015). The contribution of educational research to teachers' professional learning: Philosophical understandings. *Oxford Review of Education*, *41*(2), 202-216. https://doi.org/10.1080/03054985.2015.1017406

Yarullin, I. F., Tsyr Bushmelevakun, N. A., & Tsyrkun, I. I. (2015). The research competence development of students trained in mathematical direction. *International Electronic Journal of Mathematics Education*, *10*(3), 137-146. https://doi.org/10.29333/iejme/296