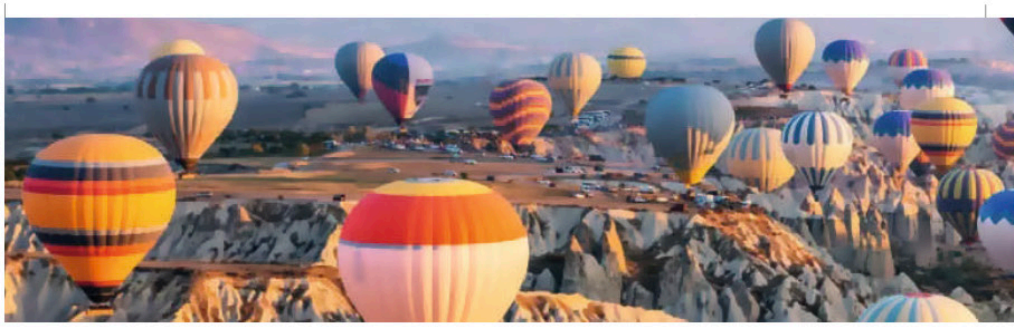

ESERA 2023 Cappadocia

The 15th EUROPEAN SCIENCE EDUCATION RESEARCH ASSOCIATION ESERA

Proceedings Book Series-V

Editors
Gokhan Kaya
Metin Sardag
Ismail Donmez

nobel bilimsel

EUROPEAN SCIENCE EDUCATION RESEARCH ASSOCIATION

ESERA

The 15th Conference of the European Science Education Research Association (ESERA)

ESERA 2023 Cappadocia

Proceedings Book Series-V

Strands 15, 16

ESERA 2023 Conference
Cappadocia, Türkiye
August 28- September 1, 2023

Editors:
Gokhan Kaya, Metin Sardag, Ismail Donmez

Foreword

It is my pleasure to introduce the proceedings of the 15th Conference of the European Science Education Research Association (ESERA) in Cappadocia, Türkiye. The conference was the first physical conference following the Covid-19 pandemic, and as such it was a wonderful opportunity for the ESERA community to reconnect in person and to learn about our respective research across Europe and beyond. I am particularly delighted that ESERA was able to provide a platform for early career researchers and new members who joined the ESERA family during this conference. Based on my interactions with the community at the conference, the event was intellectually stimulating and socially pleasant experience for all.

The planning of the conference began when we were still in the midst of the pandemic, slowly emerging from a very challenging period globally. The three universities involved in the organisation of the conference - Hacettepe University, Gazi University, and Nevşehir Hacı Bektaş Veli University - provided enormous support throughout but it is important to note particularly the period following the devastating earthquakes in February 2023. On behalf of the ESERA Board and the ESERA community, I thank the leadership of the Local Organising Committee, namely Gultekin Cakmakci, Mehmet Fatih Tasar, and Mustafa Hilmi Colakoglu for the effective management of the preparations under such extraordinary circumstances.

The theme of the conference was "Connecting Science Education with Cultural Heritage", one of the main goals of UNESCO, the United Nations Educational, Scientific and Cultural Organization. As a culturally diverse country with a rich heritage, Türkiye provided a brilliant context to consider research in science education in diverse social learning environments.

The five books of the conference proceedings have been edited by Gokhan Kaya, Metin Sardag, Mehmet Sogut, Tugba Ecevit, Kibar Gul, Orhan Curaoglu, Bahadir Altintas and Ismail Donmez. We acknowledge and thank them for their editorial input into the ESERA 2023 conference proceedings.

I hope that the conference proceedings will serve not only as a memory of a useful conference but also a forum where the newly established professional networks can flourish further, and help enhance our understanding of improving science education through research.

Sibel Erduran

ESERA President (2019-2023)

University of Oxford, UK

Foreword

A very warm welcome to the European Science Education Research Association (ESERA). The preparation for the conference began more than 2 years before the conference. We received around 1300 submissions. After a review process, we had 695 Papers, 54 Symposia, 2 Panels, 20 Workshops, 150 Posters with 3 plenary speakers and 2 ESERA community plenary speakers. With on-site registration, there were around 1100 participants. After a review process, 195 manuscripts were accepted to be part of these five eProceedings.

As always ESERA supports early-career researchers. We think that everything needs to be done to keep their enthusiasm fresh and alive for developing a science education culture. Drawing upon that we had five workshops for early-career researchers and practitioners as part of the programme for the ESERA 2023 conference. That brings fresh enthusiasm to the new and young generation of researchers and practitioners in STEM education around the globe. Providing opportunities for early-career researchers to serve on the editorial board for the development of these five eProceedings is one of the outcomes of that initiative.

Spanning Europe and Asia, it can be said that Türkiye has been the meeting place of many peoples and cultures throughout the centuries. Having colleagues from over 65 countries at this conference in Cappadocia, a historical region in Central Anatolia, enabled us to show our way of mutual understanding, respect, and cooperation which is also much needed in today's world. Accordingly, the theme of the ESERA 2023 conference was "Connecting Science Education with Cultural Heritage".

The ESERA 2023 conference was a great success with all conference participants and science education around the world. These five eProceedings will allow us to further debate in the field. We look forward to these valuable interactions and experiences, developing partnerships, and significant outcomes of the conference.

On behalf of the Local Organizing Committee of the ESERA 2023 Conference, I would like to thank everyone who has contributed to this conference and eProceedings in different capacities.

Looking forward to seeing you all at the ESERA 2025 Conference in Copenhagen, Denmark!

Gultekin Cakmakci

ESERA 2023 Conference President
Hacettepe University STEM & Maker Lab, Türkiye

Connecting Science Education with Cultural Heritage

Proceedings of the ESERA 2023 Conference

Publication No.: 2280

ISBN: 978-625-393-908-3

Edition Number: 1st Edition, September 2024

Editors for Proceedings Book Series-V:

Gokhan Kaya, Metin Sardag, Ismail Donmez

Co-editors for Proceedings Book Series-V:

María Ruth Jimenez Liso, Hasan Özcan, Claudio Fazio, Ilídio André Costa

The Proceedings of ESERA 2023 is an electronic publication for revised and extended papers presented at the ESERA 2023 conference in Cappodocia, Türkiye during the August 28- September 1, 2023. All papers in the eProceedings correspond to communications submittedand accepted for the ESERA 2023 conference. All proposals to the conference went through a blind review by two or three reviewers prior to being accepted to the conference. A total of 695 papers, 54 symposia, 2 panel, 20 workshops, 150 posters were presented at the conference and in total 195 papers are included in the eProceedings.

The authors were asked to produce updated versions of their papers and take into account the discussion that took place after the presentation and the suggestions received from other participants at the conference. On the whole, the eProceedings presents acomprehensive overview of ongoing studies in Science Education Research in Europe and beyond. This book represents the current interests and areas of emphasis in the ESERA community at the end of 2023.

The Proceedings book series divided five different books eighteen parts that represent papers presented across 20 strands at the ESERA 2023 conference. The stand chairs for ESERA 2023 co-edited the corresponding part for each strand 1 to 20 and. All formats of presentation (single oral, interactive poster, ICT demonstration/workshop and symposium) used during the conference were eligible to be submitted to the eProceedings.

The co-editors carried out a review of the updated versions of the papers that were submitted after the conference at the end of ESERA 2023. The editors and co-editors do not necessarily endorse or share the ideas and views presented in or implied by the papers included in this book.

The appropriate APA style for referencing this *Proceedings Book Series-V* is as follows:

Kaya, G., Sardag, M., & Donmez, I. (Eds.) (2024). Proceedings Book Series-V of the ESERA 2023 Conference. Connecting Science Education with Cultural Heritage. Cappadocia, Türkiye. Nobel Bilimsel Eserler

The appropriate APA style for referencing individual papers in the eProceedings is as follows:

[Author(s)]. (2024). [Title of article]. Kaya, G., Sardag, M., & Donmez, I. (Eds.) (2024). Proceedings Book Series-V of the ESERA 2023 Conference. Connecting Science Education with Cultural Heritage, Strand number (co-ed. [Editors of the strand chapter]), (pp. [page numbers]). Cappadocia, Türkiye. Nobel Bilimsel Eserler

Editorial

We are pleased to present the fifth book in the ESERA 2023 Conference Proceedings Series, which compiles the work presented in Strands 15 and 16. This book reflects the dedication and innovation of educators and researchers committed to enhancing the quality of science education through the professional development of pre-service and in-service teachers.

Strand 15, titled *Pre-service Science Teacher Education*, encompasses studies focused on the preparation of future science educators. The 23 contributions in this section explore diverse approaches, strategies, and methodologies aimed at equipping pre-service teachers with the knowledge, skills, and attitudes essential for effective science teaching. These studies provide valuable insights into the pedagogical frameworks, educational resources, and instructional practices that shape the experiences of teacher candidates during their formative years in the profession.

Strand 16, titled *In-service Science Teacher Education and Professional Development*, highlights research dedicated to the continuous learning and growth of practicing science teachers. The 23 studies included in this section address various facets of professional development, from innovative training programs and collaborative learning environments to reflective practices and new pedagogical techniques. This strand underscores the importance of supporting in-service teachers in adapting to the evolving demands of science education and maintaining a high standard of teaching excellence.

The collective knowledge presented in this volume emphasizes the critical role that teacher education plays in shaping the future of science education globally. By bringing together the work of scholars, educators, and practitioners, this book serves as both a resource and an inspiration for those committed to fostering meaningful science learning experiences across diverse educational contexts.

We extend our gratitude to the authors, reviewers, and conference organizers who contributed to the development of this proceedings book. We hope that the research shared here will inform and inspire ongoing discussions and initiatives in science teacher education.

We invite you to explore the rich and diverse perspectives offered in this collection and trust that the studies presented here will spark new ideas and further the progress of science education research.

Warmest Regards,

Gokhan Kaya, Metin Sardag, Ismail Donmez

Hacettepe STEM & Maker Lab

August 2024

Contents

Editorial **4**

Strand 15. Pre-service Science Teacher Education **8**

Preservice Science Teachers' Performance in Engineering Design Processes in the Sultanate of Oman 10
The "Factory of Ideas for Natural Science" Project: Teaching Innovation to Address Energy with Future Teachers 16
Teachers' Storytelling Production for Teaching Science with Sensitivity to Cultural Diversity 24
Reflective Experimenter: Fostering Experimental Skills Through Videography 32
Continuous Improvement of Preservice Teachers' Instructional Design Skills in Professional Development Program: Use of Reflection and Feedback 40
Development and Evaluation of a Practical Course for the Technology Teacher Training 54
Integration of Biology, Chemistry, and Physics Concepts When Analysing Socio-Scientific Issues by Science Teachers in Initial Training: A Study by Semantic Networks 66
Elementary School Pre-Service Teachers' Usability Evaluation of an App for Inquiry Teaching 74
Crafting the 21st-century Preschool Teachers: Designing Inclusive Science Learning Environments .. 82
A Comparative Content Analysis of Chemistry Education Master's Thesis in Finland and Türkiye 92
Implementation of "Ambitious Science Teaching" Framework with Pre-service Teachers 100
Using the PCK Map Approach to Obtain Validity Evidence Based on Response Processes for a Multiple-Choice Instrument 114
Investigating the Effect of Argument-Driven Inquiry in Pre-service Science Teachers' Self-Efficacy to Teach Science Through Argumentation 128
Insecurity and Knowledge About Inquiry Science Education: Initial Perceptions of Pre-Service Early Childhood Education 134
The Effect of Technology-Based Concept Tools on Pre-Service Science Teachers' Views About Concept Teaching 142
Primary Pre-Service Teachers' Understanding of STEAM Education Through Lesson Planning 158
Semantic Waves and Attention to Language to Encourage Student Teachers' Development of Scientific Language and Science Understanding 170
Multimodality in Pre-service Chemistry Teachers and Integrative Project in Textbooks 180
Exploring The Development of Pre-Service Chemistry Teachers' Pedagogical Content Knowledge During the Brazilian Pedagogical Residency Program 194
The Effect of Argumentation Supported STEM Education Activities on Teacher Candidates' Scientific Reasoning Skills 204
Improvement of Diagnostic Competences Using Video-Supported Training Moduls a Design-Based-Research-Study 212
Teaching Internship Preparation on The Next Level – A Scrum-Based Concept for The Preparatory Seminar 222
Elementary Preservice Teachers Adapting Discourse Moves in Microteaching 232

Strand 16. In-service Science Teacher Education and Professional Development 240

Meaningful Learning of Exoplanetology and Habitability 242
Science Teachers' Competencies in Designing Argumentation Activities: An Action Research 250
Teachers' Competence in Using Educational Technologies: The Case of Science Education Teachers in Turkey 266
Inquiry-Based Learning Teaching as a Basis for Building Research Projects in Science Education and Human Rights: An Experience from In-Service Teacher Training Course 292
Primary School Teachers' Self-Efficacy in Science Teaching: The Impact of a Multidimensional Training Programme 304
Comparison of the Teacher Identity Perception of Novice Science Teachers Through a Mixed-Methods Approach 314
Investigating Science Teachers' Pedagogical Content Knowledge Related to Climate and Weather ... 326
Examination of High School Physics Teachers' Professional Identity in Turkey 338

ESERA 2023 Cappadocia TÜRKİYE

A Comparative Content Analysis of Chemistry Education Master's Thesis in Finland and Türkiye

Dilek Teke[1], Jarkko Lampiselkä[2] and Mustafa Sözbilir[1]

[1]Atatürk University, Türkiye,

[2]Hensinki University, Finland

This research aims to compare the chemistry education master's thesis published in Finland (FIN) and Türkiye (TR) by the content analysis of the chemistry subject, didactic focus, main aim of the study, research methods, data collection tools, target audiences and data analysis. Data were gathered from a total of 90 chemistry education master's theses, 48 from TR and 42 from FIN, between 2015-2019. The results were presented by descriptive statistics in the form of charts, percentages and frequencies in tables. Results indicated that matter and related titles such as physical and chemical states, change of state, particulate nature of the matter in TR and practical works in FIN come to the fore as the chemistry subject of master's theses. In addition, the didactic focus of the thesis is mostly the results of the student's actions, course and causal relations and/or predictions; In FIN theses, the teacher's didactic activities are focused on the course and causal relations and/or predictions. In addition, TR theses are employed more qualitative approach while FIN theses are more focused on mixed approach.

Keywords: Chemistry education, master thesis, Finland and Türkiye

Introduction

Comparative research is important in terms of cultural, economic, political, ideological and educational aspects (Schreiner & Sjøberg, 2004). In addition, comparative studies are common in the study of international education systems. This type of research helps to compare the education systems across the countries, identify the rising issues, and make further decisions to reform education (Meyer & Benavot, 2013).

Liu and Dervin (2017) noted that many researchers examine Finland as it consistently ranks high in PISA assessments. Although the education systems in the countries studied are generally very similar, FIN places more emphasis on teacher training (Erdoğan & Savaş, 2022). Teacher training programs provide pre-service teachers with the necessary knowledge and skills to work independently as experts and develop their fields (Niemi & Lavonen, 2020; Tirri, 2014). In addition, teacher training provides sufficient research knowledge and skills

to develop self-directed teaching practices (Jakhelln et al., 2021); therefore, master's level education is important in acquiring such qualifications (Niemi & Lavonen, 2020). This research aims to compare the chemistry education master's thesis published between 2015 and 2019 in Finland [FIN] and Türkiye [TR] by the content analysis of the chemistry subject, didactic focus, main aim of the study, research methods, data collection tools, target audiences and data analysis.

The comparison of the two countries with different teacher education practices, based on the MA theses, which are an important product of teacher education, in terms of research method, data collection tool, target group, sample size, didactic focus and data analysis, can be useful to reveal how educational processes are handled in the two countries (describe, associate, in-depth, improve). It can be useful to see the ability of the two countries to put theoretical knowledge into practice and their knowledge of research methods. It may help to get a clearer picture of the researcher-teacher identity in the two countries. It can be illuminating whether the focus is on problems for all stakeholders in the education system in the two countries. It can provide an idea of which components of the learning process (learning goals/content, student, teacher) are more focused and which are in the background in both countries. It can provide information on whether the components of the learning process are evaluated from different perspectives according to the methods used in both countries.

Within the framework of this importance, FIN and TR are two countries suitable for comparing education systems. This research aims to compare the chemistry education master's thesis published between 2015 and 2019 in FIN and TR by the content analysis of the chemistry subject, didactic focus, main aim of the study, research methods, data collection tools, target groups and data analysis.

Methodology

This study used a comparative research design to find answers to the research questions. Comparative research aims to investigate a relationship between one variable and another by examining whether one group's value of a dependent variable differs from another group's value of a dependent variable. In other words, comparative research examines differences between groups on a variable (McMillan & Schumacher, 2010). Here, comparative research can shed light on the relative strengths and weaknesses of each country's master's theses, which would not be apparent if only one country were considered (Park et al., 2020). Comparative research was used in this study because the master's theses were on chemistry education in TR and FIN.

Data Collection Tool

Data were collected using the Educational Research Papers Classification Form

(ERPCF), which was originally developed in a different study (Sözbilir et al. 2012) involving one of the authors of this study. This tool was modified based on the master's theses. In this process, the book by McMillan and Schumacher (2010) was taken as a reference to revise the main heading and sub-headings of the form. ERPCF consists of six components: (1) descriptive information about the thesis, (2) thesis discipline, (3) methodological approaches/research methods, (4) data collection tools, (5) samples and sizes, (6) data analysis methods.

Sample

The data were collected from a total of 90 master's theses in chemistry education between 2015 and 2019, 48 from TR and 42 from FIN. Table 1 shows the number of theses in TR and FIN countries according to years.

Table 1. Number of theses belonging to TR and FIN countries according to years.

Number of Thesis						
Country	2015	2016	2017	2018	2019	Total
TR	4	2	6	8	28	48
FIN	5	8	7	10	12	42

Data Analysis

The data obtained from the theses reviewed by the researchers were recorded in a spreadsheet. The results were presented using descriptive statistics in the form of charts, percentages and frequencies in tables.

Findings

In this section, data from TR and FIN theses were presented according to subject, method and target group.

In both countries, the percentage of theses where the topic was not specified was higher. However, while the trending topic in TR theses was "Matter and related titles", in FIN theses it was "Practical works". Table 2 shows the number of theses according to the topics.

Table 3. Distribution of the number of theses according to the topics.

Chemistry Education Topics					
FIN	f	%	TR	f	%
Practical works	6	14.3	Matter and related titles such as physical and chemical states, change of state, particulate nature of matter etc.	6	12.5
General chemistry	3	7.1	Chemistry textbooks	5	10.4

Biochemistry	2	4.8	Chemistry concepts	4	8.3
Chemistry technology	2	4.8	Environmental chemistry	3	6.3
Drugs / Pharmaceuticals	2	4.8	Nano chemistry	3	6.3
Environmental chemistry	2	4.8	Solution/s solubility and concentration	3	6.3
Materials Science	2	4.8	Acids and bases	2	4.2
Acids and bases	1	2.4	Atom and related titles (such as models, mass size etc.)	2	4.2
Catalysis	1	2.4	Chemical equilibrium	2	4.2
Chemical bonds	1	2.4	Gases and related titles such as gas laws, gas properties, pressure, diffusion etc.	2	4.2
Chemistry in society	1	2.4	Liquids	2	4.2
Forensic science	1	2.4	Biochemistry	1	2.1
Nutrition	1	2.4	Ionization energy	1	2.1
Polymer chemistry	1	2.4	Laboratory and related titles	1	2.1
Separation science	1	2.4	Periodic system	1	2.1
Spectrophotometry	1	2.4	Water	1	2.1
Others	14	33.3	Others	9	18.8

Table 3 shows that according to "Didactic focus of thesis" the most common studies in TR theses was "Teacher's didactic activities" and in FIN theses it was "The results of the student's actions". However, it was observed that the percentage of theses with "Goals and Contents" was close to each other in both countries.

Table 3. Percentage of the theses by the didactic focus.

The didactic focus of the thesis	TR	FIN
1. Goals and Contents	15.6	18.9
2. Student	2.2	7.5
3. Teacher	1.1	5.7
4. Relationship between the student and the teacher	0.0	1.9
5.1 Student's understanding of and attitude about goals and contents	20.0	24.5
5.2. The actions (e.g. studying) the students do to achieve the goals	0.0	1.9
5.3. The results of the student's actions	4.4	**39.6**
6. Relation between the goals/contents and the teacher	5.6	0.0
7.2. Teacher's conceptions of students' actions towards achieving goals	1.1	0.0
7.3. Teacher's didactic activities	21.1	0.0
7.4. Teacher's reflections on his/her own didactic actions	11.1	7.5
8. Relation between student and teacher's didactic actions to enhance learning	17.8	0.0

Table 4 shows that according to "Level of thesis" the trend in both theses was "Course". However, while "Society" was the trend in TR, "Teaching

Organization" was the trend in FIN.

Table 4. Percentage of the theses by the analysis level.

Level	TR	FIN
Course	54.8	58.3
Society	23.8	16.7
Teaching Organization	21.4	25.0

Table 5 shows that according to " Main aim of study " the trend in both theses was about "Describing, understanding and/or interpreting". However, while " Causal relations and/or predictions " was the trend in TR, " Improvement, development, and /or empowerment " was the trend in FIN.

Table 5. Percentage of the theses by the main aim of the study.

The main aim of the study	FIN	TR
Causal relations and/or predictions	5.5	41.7
Describing, understanding and/or interpreting	57.1	52.1
Improvement, development, and /or empowerment	42.9	6.3

As Table 6 shows, TR's preference for quantitative research was experimental, while FIN's was mixed.

Table 6. Percentage of the theses by the research design.

	Mixed	Qualitative		Quantitative	
	Mixed	Analytical	Interactive	Experimental	Non-experimental
FIN	25	1	11	4	1
TR	6	8	10	16	8
Total	31	9	21	20	9

Table 7 shows that according to data collection tools the trend in TR theses was " Tests/Batteries" and in FIN it was "Questionnaires".

Table 7. Percentage of the theses according to the data collection tools.

TR	%	FIN	%
Tests/Batteries	32	Questionnaires	60
Scales/Inventories	13	Interviews	17
Documents	12	Documents	14
Interviews	10	Tests/Batteries	6
Alternative data collection instruments	8	Observation	2
Questionnaires - Open ended	7	Alternative data collection instruments	1
Observation	5	N/A	1
N/A	1		

Table 8 shows that according to the target group, the trend in TR theses was " ISCED 3 (Upper Secondary education)" and in FIN it was "Teachers". In addition, while the sample size in TR theses was between 11-50 with a value of 13%, it was between 11-50 with a value of 23% in FIN theses.

Table 8. Percentage of the theses by the target group and the sample size.

TR	%	FIN	%
ISCED 3 (Upper Secondary education)	23	Teachers	20
ISCED 6 (Bachelor's or equivalent level)	12	ISCED 3 (Upper Secondary education)	15
Not Applicable	8	ISCED 6 (Bachelor's or equivalent level)	9
ISCED 2 (Lover Secondary education)	6	Not Applicable	8
Teachers	3	ISCED 2 (Lover Secondary education)	6
ISCED 7 (Master's or equivalent ed.)	1	ISCED 7 (Master's or equivalent ed.)	6
		ISCED 0 (Pre-school education)	1
		Others	1
		ISCED 4 (Post-second non-tertiary education)	1
		ISCED 8 (Doctoral or equivalent ed.)	1
Between 11-50	13	Between 11-50	23
Between 51-100	10	Between 1-10	8
Between 101-200	8	Between 51-100	5
Others	8	Not reported	2
Over 500	4	Others	2
Between 201-500	3	Between 201-500	1
Between 1-10	2	Over 500	1

Table 9 shows that according to data analysis, the trend in TR theses was "Descriptive statistics in tables and Charts or Figures" and in FIN it was "Descriptive (narrative) qualitative analysis".

Table 9. Percentage of the theses according to the data analysis methods

TR	%	FIN	%
Descriptive statistics in tables	48	Descriptive (narrative) qualitative analysis	28
Descriptive statistics in Charts or Figures	48	Content (Thematic) analysis	26
Content (Thematic) analysis	23	Descriptive statistics in tables	20
t-test	17	Descriptive statistics in Charts or Figures	19
Non-Parametric tests	13	t-test	1
ANOVA/ANCOVA	6	Correlation analysis	1
MANOVA/MANCOVA	1	Non-Parametric tests	1
Descriptive (narrative) qualitative analysis	1	N/A	1

Conclusion

The main results indicate that matter and related titles such as physical and chemical states, change of state, particulate nature of the matter in TR and practical works in FIN come to the fore as the chemistry subject of master's theses. In addition, the didactic focus of the theses are mostly the results of the student's actions, course and causal relations and/or predictions; In FIN theses, the teacher's didactic activities are focused on the course and causal relations and/or predictions. In addition, TR theses employ mostly quantitative research designs while FIN theses are mostly focused on mixed methods designs.

References

Erdoğan, P., & Savaş, P. (2022). Investigating the selection process for initial English teacher education: Turkey. *Teaching and Teacher Education*, *110*, 103581.

Jakhelln, R., Eklund, G., Aspfors, J., Bjørndal, K., & Stølen, G. 2021. Newly qualified teachers' understandings of research-based teacher education practices–two cases from Finland and Norway. *Scandinavian Journal of Educational Research*, *65*(1), 123-139. https://doi.org/10.1080/00313831.2019.1659402

Liu, H. & Dervin, F. 2017. Education is a life marathon rather than a hundred-meter race: Chinese 'folk' comparative education discourses on Finnish education. *Compare: A Journal of Comparative and International Education*, *47*(4), 529-544.

Schreiner, C., & Sjøberg, S. (2004). Sowing the seeds of ROSE. Background, rationale, questionnaire development and data collection for ROSE (The Relevance of Science Education)-a comparative study of students' views of science and science education (Acta Didactica 4/2004). Oslo: Dept. of Teacher Education and School

Development, University of Oslo. www.ils.uio.no/forskning/publikasjoner/actadidactica/index.html

Meyer, H. D., & Benavot, A. (Eds.). (2013, May). *PISA, power, and policy: The emergence of global educational governance*. Symposium Books Ltd.

McMillan, J. H. & Schumacher, S. (2010). *Research in education: Evidence-based inquiry* (7th Edition). Pearson.

Niemi, H., & Lavonen, J. 2020. Teacher education in Finland: Persistent efforts for high-quality teachers. *Teaching the World's Teachers*. https://helda.helsinki.fi/bitstream/handle/10138/326792/Niemi_Lavonen_HN_Revised_22010_CLEAN_Teacher_education_in_Finland_1980_today.pdf?sequence=1

Park, W., Wu, J. Y., & Erduran, S. (2020). The nature of STEM disciplines in the science education standards documents from the USA, Korea and Taiwan: Focusing on disciplinary aims, values and practices. *Science & Education, 29*, 899-927.

Sozbilir, M., Kutu, H., & Yaşar, M. D. (2012). Science education research in Turkey: A content analysis of selected features of papers published. In J. Dillon and D. Jorde (Eds). *The world of science education: Handbook of research in Europe* (pp.1-35). Rotterdam: Sense Publishers.

Tirri, K. 2014. The last 40 years in Finnish teacher education. *Journal of Education for Teaching, 40*(5), 600-609 https://doi.org/10.1080/02607476.2014.956545

ESERA 2023 Cappadocia TÜRKİYE

CERTIFICATE

OF PRESENTATION

This is to certify that

Dilek Teke

made an “Parallel Session - 8.21 (Oral Presentations)” entitled “A Comparative Content Analysis of Chemistry Education Master’s Thesis in Finland and Türkiye” at the 15th Conference of the European Science Education Research Association, held on August 28 - September 1, 2023 in Cappadocia, Türkiye.

Gultekin Cakmakci

ESERA 2023 Conference President

Sibel Erduran

ESERA President