Research in Teacher Education

Implementing evidence-informed teaching practices

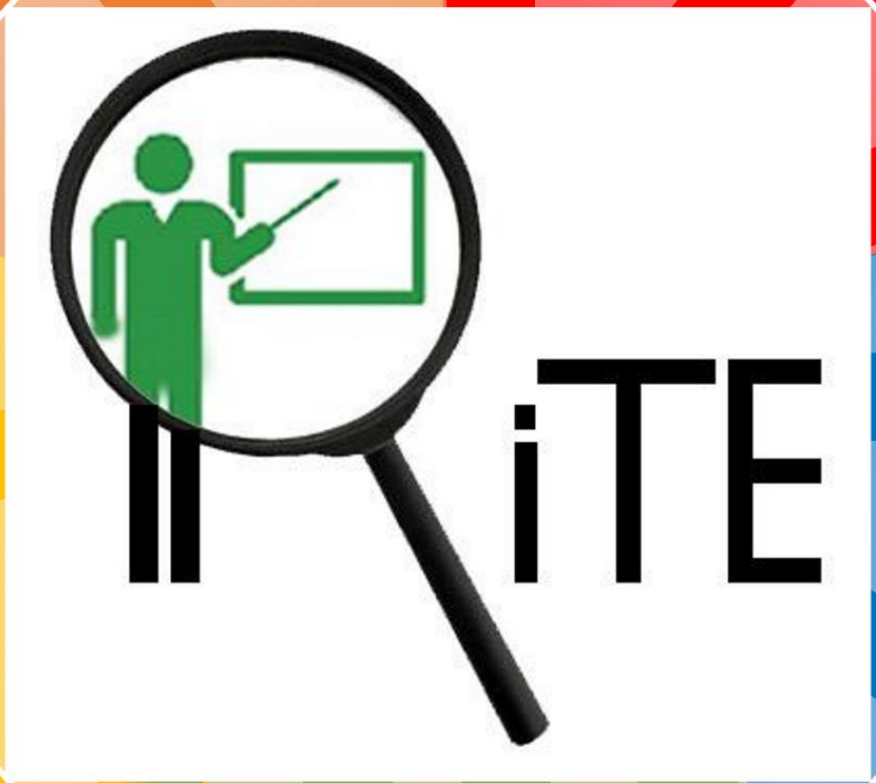

Figure 1 Group picture taken during the first transnational project meeting in Groningen (November 2019)

Context:

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Contents

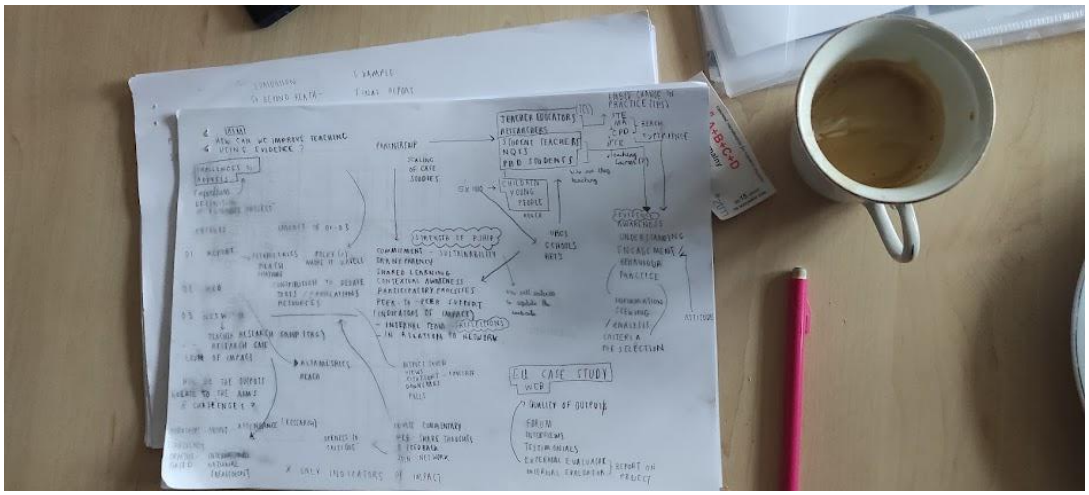

Figure 2 Notes about the project taken during the final transnational project meeting in Poznan

Figure 3a

Figure 3b

Figure 3a-c Social activities during our visit in Pozan

Figure 3c

Summary

This project responded to two major challenges of our societies on a European dimension: 1. the current challenge of evidence-informed decision-making in an age where pieces of evidence are increasingly ignored by policymakers worldwide and the amount of information is increasingly complex; 2. the need regarding the strengthening of initial teacher education and continuous professional development. This project addressed these challenges by building a support structure for (future) teachers in science, technology, engineering, and mathematics (STEM) by educating trainees in implementing evidence-informed practices to improve their teaching and learning processes. The project stimulated a European-wide collaboration between trainees and practitioners to exchange good practices in evidence-informed activities.

The aim of the RiTE-project was to promote and facilitate (student) teachers to implement evidence-informed teaching practices in STEM-education. In this project, (student) teachers were stimulated to use evidence from educational and scientific research to experiment and innovate their teaching and learning processes. This project allowed us to support teachers and teacher trainers to develop and innovate their educational practice based on evidence, and as such contribute to reducing the gap between theory and practice in initial teacher education (ITE).

In order to address the aim of this project, five partners worked together on professional development activities in two distinct phases. In phase I, all partners used their local ITE context to construct a support structure, including teaching strategies and materials, for cohorts of trainees to integrate evidence-informed practices into the ITE-curriculum. In this way, student teachers developed more solid skills to integrate evidence into their current and future teaching practices (research literacy). The strategies and materials were presented in five different case studies, which served as learning resources for the second phase. In phase II a sample of teachers (who were participants in phase I) was supported in their first teaching year in maintaining their evidence-informed teaching practices by using the support structures developed in phase I. Using a multi-method approach, the partners analysed the collected data to come to useful recommendations for other ITE institutions that would like to get more evidence into their teaching practices.

The support structure developed in the RiTE project consisted of three components:
1. a multimedia website including five case studies presenting how the teaching and learning trajectories in which evidence-informed practices were integrated.
2. a report with the empirically validated support structure and recommendations of participating teachers and teacher educators about how they managed to maintain their evidence-informed perspective.
3. a European support network of educational researchers, teacher trainers, and teachers in which literature, lesson materials, expertise, and experiences are shared regarding creating and embedding an evidence-informed practice.

1. Context & Objectives

The aim of the RiTE-project was to promote and facilitate (student) teachers to create an evidence-informed teaching practice in science, technology, engineering and mathematics (STEM) education. In this project, (student) teachers were stimulated to use evidence from educational and scientific research to experiment and innovate their teaching and learning processes. With evidence-informed teaching practices we allude to the use of current relevant research to plan lessons. This project responded to two major challenges of our societies on a European dimension: 1. it addressed the current challenge of evidence-informed decision-making in an age where pieces of evidence are increasingly ignored by policymakers world-wide and the amount of information is increasingly complex leading to initiatives such as EU4FACTS (EC, 2015); 2. it addressed the need that the European Commission (EC) has recently put down regarding the strengthening of initial teacher education (ITE) an continuous professional development (CPD). We perceived educational settings as decisive for educating later decision-makers for evidence-informed policies who need role models in their teachers. Consequently, we endeavour to apply the strategies of evidence-informed policy making (Breckon & Dodson, 2016) to ITE-settings.

EU4FACTS
Evidence for Policy

The EC (2015) identified ITE as a fundamental area for education policy to support a shift towards new working cultures and teaching practices, to lay the foundations for teachers' capacity to adapt to changing contexts and circumstances and to increase the attractiveness of a teaching career. This policy focuses on three major policy challenges: 1. designing an integrated and career-long perspective on teachers' professional development; 2. promoting collaborative learning among teachers; 3. governance of ITE. This project addressed the challenges 1&2:

1) To support CPD, this project aimed to build a support structure for future teachers in STEM-education by educating trainees in creating an evidence-informed practice to improve their teaching and learning processes. As the mentioned guide stated: "This period can cover a wide range of activities, including: learning from communities of practice, lesson study, action research, self-study and formal courses leading to qualifications. Support structures during this phase enabled coherence between these different activities and relevance to the individual needs of teachers." (p. 17). The recommended policy actions also included that the structure "should support student teachers and teachers to use and engage in research in their practice." (p. 35).

2) This project stimulated collaboration between trainees and practitioners to exchange good practice in evidence-informed activities. The European Guide recommended that support structures should "facilitate group learning, support experimental activities and promote exchange of experience between teachers" (p. 35) and enable "the use of new technology to exchange good practice, experience and learning outcomes." (p. 49)

In order to address the aim of this project, five partners in ITE worked together on professional development activities (PDAs) in two distinct phases. In phase I all partners used their local ITE context to construct a support structure for cohorts of 10-20 trainees to integrate evidence-informed practices into the ITE curriculum. In phase II around 5 teachers (who were participants in phase I) were supported in their first teaching year in maintaining their evidence-

informed teaching practices by using the support structures developed in phase I. Formulated as concrete questions, this project asked:
1. How can trainee STEM teachers be supported with integrating evidence from educational and scientific research in their teaching practice?
2. Can the strategies of evidence-use mechanisms for policymakers be applied to initial teacher training and CPD?
3. How can the findings of question 1 and 2 be used to support teachers to put into action evidence- informed small scale innovations in their first year of teaching practice?

Addressing these questions allowed us to support teachers and teacher trainers to develop and innovate their educational practice based on evidence, and as such contribute in reducing the gap between theory and practice in ITE. Following the European guidelines and the multilateral challenges, we stressed that this project was best situated in a transnational context. This allowed us to design robust solutions for ITE and CPD in different European contexts (NL, UK, DE and PL). We shared our different international experiences and combined them in one effective strategy applicable to a broad range of European contexts, adhering to the strategies formulated by the European Commission, and promoted the reuse of open educational resources (OER).

Figure 4 Meeting each other (for the first time) in Poznan

2. Intellectual outputs

Although the target audience initially consisted of students from ITE institutions, we expected that the findings would be equally interesting for CPD. Concretely, the support structure developed in the RiTE-project consisted of three components:

2.1 Intellectual Output 1

A multimedia website was delivered, presenting five case studies, course designs, teaching materials, and scientific sources concerning evidence-informed teaching practices provided by each of the five RiTE partners. The presentations of the case studies were embedded in an interactive environment, that supports teachers in searching and translating scientific information to use in their teaching practice. The presentations of the case studies included:

rite-project.eu

- A description of the application of the six evidence-use mechanisms to teacher training with concrete examples;
- A thorough description of each of the partner's implementation of the 'expansive learning cycle' for evidence-informed teaching practices;
- Multimedia resources (e.g. audio, video) exemplifying the practice;.
- Worksheets and teaching resources belonging to the implementation of evidence-informed teaching practices;
- Interactive options to communicate and network among visitors.

2.2 Intellectual Output 2

A research report was delivered with recommendations from a longitudinal study concerning first-year teachers. The report described:

- A problem statement, that aimed to improve and study the evidence-informed teaching practices of new teachers;
- A short description of relevant literature;
- The methodology, concerning a mixed methods approach in which we utilized several instruments to collect data;
- The results from the analyses, leading to recommendations for the field.

2.3 Intellectual Output 3

A European support network of educational researchers, teacher trainers and teachers in which literature, lesson materials, expertise and experiences were shared, regarding creating and embedding evidence-informed practices. The participants in the RiTE-project formed the initial core of the network. The DUDOCnetwerk, in collaboration with Utrecht University, coordinated the network in order to sustain and further develop the activities, materials, and publications. The report presenting all support network activities and products was shared at the results platform of Erasmus+.

Erasmus+
results platform

3. Complementary & Innovative

The RiTE project was innovative because it addressed a gap in evidence-informed teaching practices by suggesting strategies to integrate them into ITE. Unlike other projects on CORDIS, we focused on research literacy for all subjects in STEM education, rather than an inquiry focus. The collaboration of five international partners was built upon work by an existing network of researchers in domain-specific pedagogy (DUDOCnetwerk) that aimed to bridge the gap between educational research and practical (professional) development.

dudocnetwerk.nl

Teachers develop their curriculum and innovated their teaching practice continuously. During these processes they experiment in class, try new pedagogical approaches, develop new ways of teaching domain-specific content and skills, and try new (IT)-tools and equipment to support their students' learning processes within their discipline or domain. However, teachers hardly base their experiments on evidence and results from educational research and rarely use scientific sources of information to improve their teaching practice (Broekkamp & van Hout-Wolters, 2007). The European Commission (2015) suggested that policies and actions for teacher training programmes and schools should support student teachers and teachers to use evidence and engage in research activities to improve their teaching practice. In addition, policies and actions also should ensure that schools have links with universities and other organizations that support the evidence-informed development of teaching practices. From the perspective of career-long CPD, PDAs and support actions can cover a wide range of activities, including learning from communities of practice, lesson study, action research, self-study, and formal courses leading to qualifications. It is important that such activities facilitate group learning, support experimental activities, and promote the exchange of experience and expertise between teachers (European Commission, 2015, p. 35).

The RiTE project contributed to the above-mentioned activities. The project addressed the practices of pre-and in-service teachers in secondary and tertiary education, in which little attention is paid to a systematic evidence-informed approach in developing curricula and innovating teaching and learning processes. This might be due to many factors, like the unavailability of a suitable source for scientific information, a lack of competence in reading, interpreting, evaluating, and using scientific information, and social and organizational factors within the school (Lohman, 2006). As a consequence, we experienced that there often is little attention to teachers' professional development in competencies required for evidence-informed teaching practice (Van Veen, Zwart, Meirink, & Verloop, 2010). In addition, we assumed that with the incorporation of evidence in undergraduate curricula, the learning outcomes of students with regard to the development of reflective judgment and problem-solving may increase.

In this project, we implemented an evidence-informed approach in which teachers conducted small-scale experiments (Engeström & Sannino, 2010), such as action research and lesson study (Rock & Wilson, 2005) to base their teaching practice on results from educational and domain-specific research and scientific resources. This encouraged them in innovating their teaching practice and as such in the process of educational change. In such an approach, teachers set their own learning objectives and experiments in interaction with the scientific knowledge base of their discipline. However, whether conducting experiments and research activities by teachers improves education, seemed to depend on the content and design of the specific study.

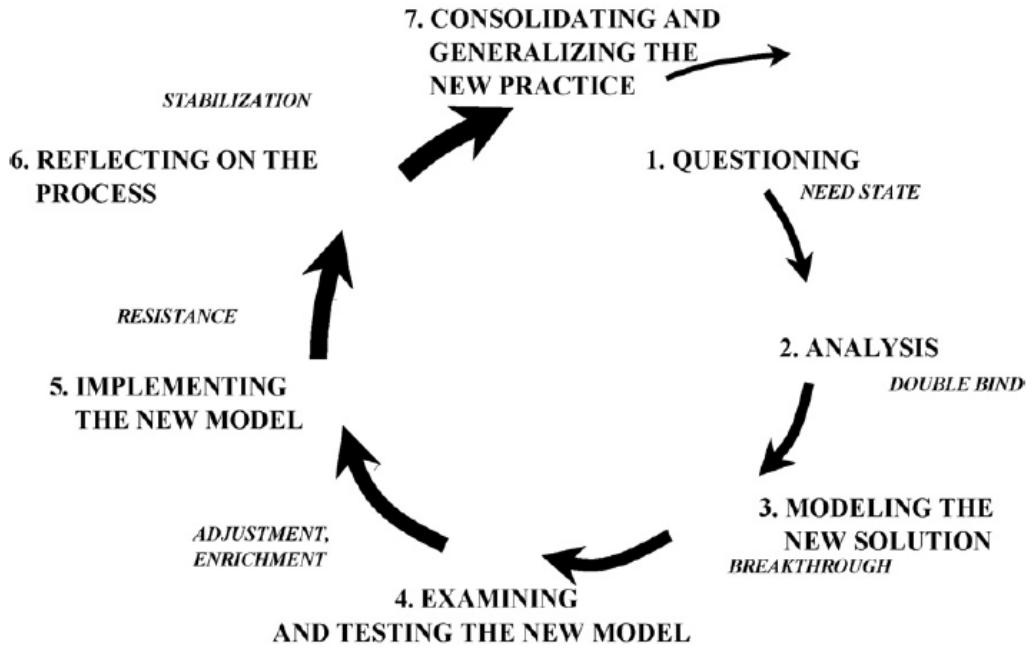

Figure 5 The expansive learning cycle (Engeström & Sannino, 2010)

4. Consortium

The partners characterized the consortium as robust, complete and learning.

Figure 6 Mapping the consortium partners in the RiTE-project

Robust, because of the academic rigour and practical experience of the partners and their prior cooperation in other projects and professional settings, such as in the H2020 project Mascil, co-teaching ITE courses in the Freudenthal Institute, co-coaching PhDs at ESERA summer school, coopering during PhD-trajectory in DUDOC-programme. Our University teacher training institutes were part of the consortium, which had the ability to collaborate with a solid network of schools in the region. Hence, they were able to identify relevant problems in these schools or study programmes, to do an evaluation on these problems and address these problems in projects. In the context of the RiTE project, difficulties to stimulate lifelong professional development of STEM teachers in practice were studied and addressed. Each RiTE partner had extensive experience in the domain of STEM teacher training and research in teacher professional development as well as potential access to implement and consolidate the approach in the respective curricula.

Figure 7 Ruins in the Citadel Park in Poznan

Complete, because of the variety across the participating teacher training institutes. The network of the partners originated from a network of teacher educators in domain-specific pedagogy (DUDOCnetwerk), that aims to bridge the gap between educational research and practical (professional) development. Within this network the researchers that work at a teacher training institute were asked to join. The consortium was complemented with other European ITE institutes, to come to a diverse group of partners in primary, secondary and tertiary education. The consortium consisted of teacher trainer institutes in urban cities (e.g. Southampton) and rural regions (e.g. Groningen, Paderborn). Most important in the context of the RiTE project was that the institutes had different but comparable approaches to stimulate professional development in the teacher training institutes (e.g. Lesson Study, Action research, ...). A focus on research and development that overarched these different approaches (Expansive learning cycle (Engeström & Sannino, 2010)) put forward design criteria for PDAs that supported (student) STEM teachers in their professional development. These design criteria were used throughout Europe in ITE as well as in CPD because of its origin in different types of PDAs.

Figure 8a

Learning, because all partners were continuously searching to optimize their ITE and CPD. The RiTE project was a great opportunity for institutions to work together internationally in the field of teacher professional development. The teacher trainers and educators engaged all had extensive experience in the domain of STEM education and all worked in an institute that was responsible for teacher professional development. In the preparation phase for RiTE it became clear that partners shared similar goals, but also had different approaches to reach that goal. The possibility to compare the different approaches was likely to strengthen the continuous learning process. The learning network was completed by inviting critical friends from the Utrecht University who had a great experience with projects and research in ITE and CPD. Science education experts of the DUDOCnetwerk and University of Utrecht monitored the project activities and outcomes and stimulated further dissemination in Europe.

Figure 8b

Figure 8c

Figure 8a-c Tour through the collection of the Biology department at Adam Mickiewicz University, showing how skill, knowledge and enthusiasm are key in STEM education

5. Responsibilities & Task division

The quality of the RiTE project was ensured by implementing an effective and efficient organizational structure with a clear distribution of responsibilities and a definition of decision-making levels with built-in control measures. The proposed structure allowed for the flexibility required for an adequate response to any contingencies, such as changes in the consortium (contract).

The project coordination was conducted by the RUG, Faculty of Science and Engineering, Undergraduate School of Science & Engineering (USSE). The USSE had extensive experience in managing projects like these. The tasks and responsibilities of the USSE were to:

- Produce a work plan, set a time scale for all project activities, and collect (intermediate) products
- Monitor the financial aspects of the project, and of its intellectual outputs to ensure that this project is completed on time and within the agreed budget
- Lead and monitor the collaboration of the participating institutions and the integration of the activities
- Set up and retain a communication and management structure to assess the progress of all activities and ensure overall quality and adherence to the Erasmus+ programme
- Establish an appropriate procedure to facilitate the communication among and reporting towards Freudenthal Institute (FI) at Utrecht University (UU) and the DUDOCnetwork as associated partners and the European Commission about financial and evaluation procedures and results.

Figure 9 First transnational project meeting ‘Kick off RiTE’ in Groningen

All partners were involved in the tasks and responsibilities regarding the intellectual outputs.

The UOS, UPB, and RUG took the lead within each of the intellectual outputs. The UOS, UPB and RUG discussed issues that occurred, made decisions about the activities, processes, and products to deliver, aligned the work that was carried out by different partners, organized

communication between partners, and collected and integrated the different products within intellectual outputs.

Regarding the intellectual outputs, the tasks and responsibilities were divided among the three partners as follows:

The UOS was responsible for (see www.rite-project.eu):

- Coordinate and collect course (re-)designs from the five partners
- Establishing and maintaining the digital repository of the project on the project website
- Development of the multimedia website containing the results, instruments, and equipment developed in the case studies to be used

The UPB was responsible for:

- Developing a theoretical framework regarding the case and field studies
- Coordinating data collection and analysis within phases I and II
- Developing the overall evaluation of the project, such as the criteria and instruments to evaluate the activities, processes, results, and products according to the quantitative and qualitative indicators and achievements

The RUG was responsible for:

- Creating the Support Network under the umbrella of the DUDOCnetwerk, the EAPRIL, ESERA, and Scientix-community.
- Coordinating the dissemination of the project products, results, and intellectual outputs

All partners were responsible for:
Conducting activities regarding the development, implementation, and evaluation of the case studies and dissemination of the results and products. Each partner conducted the case studies locally in such a way that the partners did not depend on each other to produce and finalize the results and products.

To establish short communication lines, the UOS and UPB paired up with, respectively UOC and AMU, to collaborate intensively in the case studies. The pairs shared and peer-reviewed processes, intermediate products, and deliverables using the evaluation instruments developed by the UPB.

The FI was responsible for the external evaluation of the project. The external evaluator of the FI reviewed the processes and products of the project twice during the project. He developed his own quality criteria based on their experiences and expertise. He presented at the project meetings of his own choice and he had access to all project materials and communication to be able to review the processes, results, and products.

6. Participants

All five partners were involved in teacher training for primary, secondary or tertiary STEM education. The contact persons conducted the case studies within their own teacher training programmes. The cohorts of student teachers, as well as fellow teacher trainers in these programmes, participated in this project. Cohorts within teacher training programmes of STEM education consisted of approximately 10-20 student teachers per partner. Five of these students participated in the second phase of the project. The requirement for selecting these five students, was obviously that they had a job as a teacher first year after graduation. Preferably, this was a part-time job to prevent the teachers to become overloaded and drop out due to the extra activities of this project. In addition, each teacher needed to teach at a different school or the study programme, to increase the number of schools and programmes involved in the project and to ensure a diversity of contexts to implement the case studies in the second phase of the project.

Figure 10 Session at the BRLMS conference in the United Kingdom

7. Project description

As described before, this project consisted of two phases. In the first phase, we had a look ‘inside’ the five teacher training institutions to produce five case studies on creating an evidence-informed teaching practice. In the second phase, we followed former trainees in their first year of teaching. In the preliminary phase, we did set up the appropriate management structures and disseminated relevant literature. This section describes how these phases were structured in more detail (phase Ia, Ib, and Ic; phase IIa, IIb, and IIc).

7.1 Phase I: Case studies.

The first phase was connected to our first and second research questions: each partner conducted a case study (Creswell, 2007) in their teacher training programmes for teachers in primary, secondary, and tertiary education. In this way, courses were (re)designed and supportive actions were organized to stimulate and facilitate student teachers to use evidence from educational and domain-specific research when conducting small-scale studies, experiments, and innovations in their teaching practice. The courses and supportive actions were implemented in line with the small-scale innovation learning cycle of Engeström (Engeström & Sannino, 2010). The different partners could choose their own approach, for example, lesson study, micro-teaching, action research, etc..

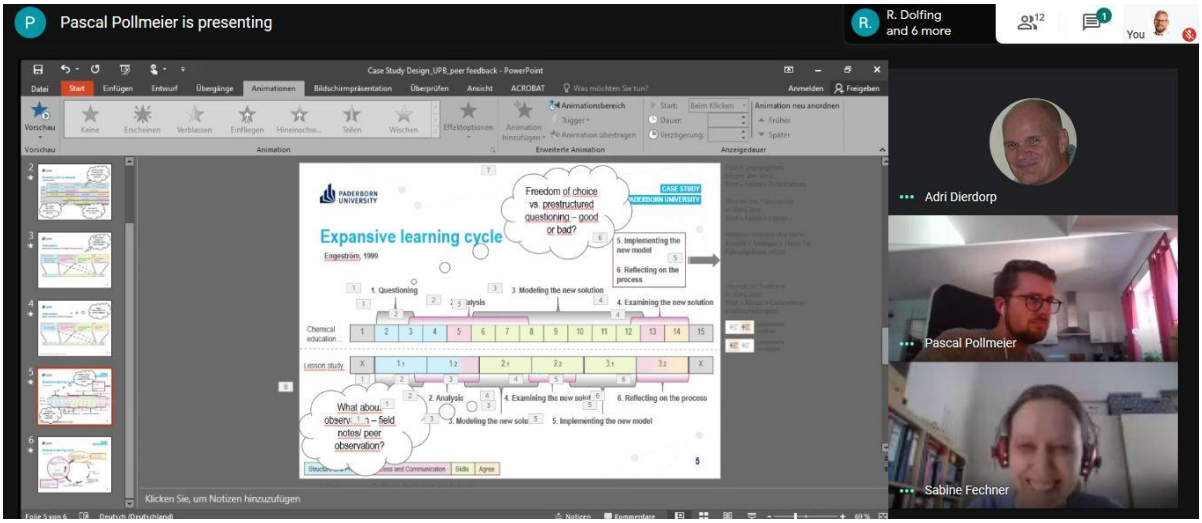

Figure 11 Alternative online three-day event replacing the second transnational project meeting

The developed courses and supportive actions contained the essential ingredients of the expansive learning cycle, such as collaboration between (student) teachers when designing and evaluating educational interventions. This meant that we first entered a design phase, in which every partner designed a research literacy-focused course, based on the expansive learning cycle. This course was then implemented and finally evaluated in a multiple case study, consisting of five case studies.

Ia. Designing PDAs based on the expansive learning cycle

The lens of expansive learning as an analysis tool for the implementation of research literacy in different PDAs brought forward possibilities and limitations of the method in its current existence. For instance, in the expansive learning cycle the use of evidence-informed sources

became more imposed in certain stages whereas, as we identified earlier, such use is not imposed by a lesson study method or other PDAs as of yet. However, it appeared to be helpful to search for connections in which the innovation of expansive learning and the practicable methods of lesson study come together. This served as a framework for analysing evidence-informed designing, performing, and evaluating actions of teacher teams. In sum expansive learning and PDAs that aimed to focus on research literacy were combined as follows:

- In the questioning stage, which preceded the design of lessons in PDAs, evidence of educational and scientific research was used to critique current practice.

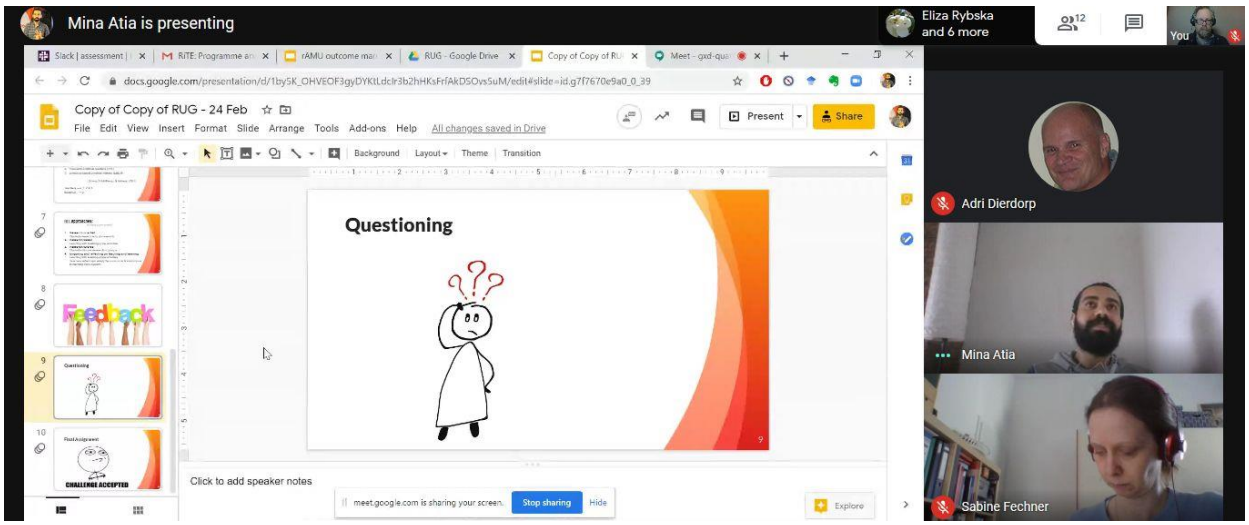

Figure 12 Presenting the case studies for peer feedback during the alternative online three-day event

- In the analysis stage, which also preceded the actual design, a conceptual framework drawn from evidence was used as an analytical lens to problematize current practice.
- In the modelling stage that touched the heart of lesson design, literature on educational research and on science was used as inspiration for designing the lessons.
- In the examining stage, which was also at the heart of the lesson study, the conceptual framework was used as an evaluation tool to identify the best working teaching model.

In the remaining three stages the created body of knowledge was used to monitor, and if necessary, intervene in the implementation of the teaching model. It should be noted, however, that the last three learning activities were not necessarily related to lesson study activity. For the designs see our project website.

Ib. Implementing the design

In the first phase, each partner implemented the expansive learning actions in their own PDA. However, to keep sight of the similarities and differences in the designing and implementing stages, online project meetings were held to inform each partner about the designs and the implementation processes in the others. The thus created data collection served as background information on the ways in which the different cases worked out their PDAs and the elements of the PDAs that could be used to evaluate the overall practicability and effectiveness of the expansive learning cycle components in the PDAs.

Ic. Evaluating the data through multiple case studies

Data collection and analysis, in every stage of the expansive learning cycle, focused on student teachers' development of the competence to read, interpret and use scientific information sources to conduct small experiments to innovate their teaching practice. The case studies included interviews, activities, and lesson observations. Qualitative (Miles & Huberman, 1994) and quantitative data analysis followed an inner case analysis. By using the stages of development in the expansive learning cycle as a common thread in all the different PDAs, we were able to compare the different cases. The analysis provided valuable insights into ways in which teacher training could implement research literacy.

7.2 Phase II: In-service teacher training as a follow-up.

In the second phase, we addressed the third question. For every partner, five student teachers who participated in the case studies (phase I) were followed during their first year of in-service teaching in a longitudinal descriptive study. In this study, data was collected and analysed to explore whether the teachers continued to use evidence from educational and/ or science research when innovating their teaching practice. In addition, factors and conditions in the school environment were explored that influenced teachers in creating and developing evidence-informed practices during the first year of in-service teaching.

IIa & b. Designing and implementing supportive actions for the induction year for teachers

The structure of supportive actions was the same for every partner. Open support: students could formulate their demands; we could then see how we could support the new teachers. This instilled a community of spirit as well. Throughout the year several data collection methods were utilized, that focused on the essential elements of the expansive learning cycle, and research literacy in particular.

IIc. Analysis of data as a longitudinal descriptive study

As every partner followed a similar structure for the support actions, we treated the data as a longitudinal descriptive study that followed around five teachers in their induction year. The study described the development of the teachers throughout the ten months.

8. Monitoring & Evaluation

In order to monitor the progress, quality, and achievements of the project the following activities were conducted:

1. Selection of experienced teacher trainers, educational developers/researchers in science education, and (design-based) research;
2. Peer review among partners of developed material and activities in case studies, and intermediate products. The UOS and UPB paired up with respectively the UOC and AMU, to collaborate intensively in conducting the case studies. After each phase, products and deliverables were shared and peer-reviewed using the evaluation instruments developed by the UPB and agreed upon with the other partners to ensure the quality of the case studies, intermediate products, and deliverables;
3. The UPB developed instruments to monitor the process, outputs, and impact of the project during the case studies. Monitoring focused on the extent to which the questions of the project were answered, the extent to which the outputs of the project were attained and used, and the user satisfaction of those who used the outputs;
4. The external evaluator participated in at least two project meetings after each phase of the project to evaluate and provide feedback on plans, processes, products, and intellectual outputs of the project. The external advisor/ evaluator reviewed the process and products of the project after each year of the project. He developed his own quality criteria based on his expertise and experience in teacher professional development and curriculum development in teacher education. After each year, he provided feedback on how to continue the project to achieve the intended objectives and results;
5. The RUG worked intensively together with the DUDOCnetwerk to ensure the transfer of project results and to create a sustainable support network. The DUDOCnetwerk was involved and engaged in the project from the beginning.

The evaluation of the project focused on three areas:

1. The extent to which the project reached its results through an evaluation of the answers to our questions

PDAs for student teachers in STEM education

Based on the evidence-use mechanisms, data collection, and analysis, every stage of the expansive learning cycle, was focused on student teachers' development of the competence to read, interpret and use scientific information sources to conduct small-scale studies and experiments to innovate their teaching practice. As a background, we used the evidence-use mechanisms for policy-makers (Breckon & Dodson, 2016) which we applied to teacher training. The case studies were accompanied by a research design that collected data on the efficacy of the implementation. Participants were observed during the sessions, a questionnaire on evidence-based practice, and semi-structured interviews after the implementation. Qualitative analysis of interviews was conducted through a coding book which was developed on the basis of the case studies at all partner locations. Adaptations of the coding book were discussed in consensus meetings. By using the stages of development in the expansive learning cycle as a common thread in all PDAs, we were able to compare the different cases. The analysis provided valuable insights into ways in which teacher training can implement evidence. The indicator for this aspect was the successful presentation of the case studies.

From policy to teaching: evidence-use mechanisms

For every partner, student teachers who participated in the case studies were followed during their first year of in-service teaching in a longitudinal descriptive study to observe whether the evidence-use mechanisms could be transferred from policy-making to teaching. In this study data (see supportive actions) were collected and analysed to explore whether the teachers continue to use results from educational research when innovating their teaching practice and how. Even changes in their conceptualization of "evidence" were analysed. Factors and conditions in the school environment were explored, that influenced teachers in developing an evidence-informed practice during their first year of in-service teaching.

Supportive actions

The structure of the supportive actions was the same for every partner i.e. open support: teachers could formulate their demands to inform project partners how to support the new teachers. Throughout the year several data collection methods were utilized that focused on the essential elements of evidence-use in particular (See annex O2). As every partner had followed a similar structure for the supportive actions, we could treat the data as a longitudinal descriptive study that has followed approx. 20 teachers in their induction year. The evaluation described the development of the teachers throughout the project period. Once more, the evidence-use mechanisms served as primary categories for the qualitative analysis of the (collective) learning actions to which competencies to read, interpret and use scientific information sources are added.

2. The attainment and use of the outputs

To examine if the outcomes of the project were achieved and used, two data collection methods were planned to be deployed. The first was that the multimedia website kept track of what university teachers and students log in and what tools and publications were used (hits and unique users) now and in the future. The second was that during the project meetings not only the contents of PDAs were being discussed but also the use of the tools and publications on the multimedia website. In this way, we could see what (network) tools were used, how often these were used, and what reasons there were to (not) to use them. Visitor counts of the website, however, stayed behind our expectations, and therefore during the last transnational meeting, we held a website session and furthermore collected feedback on the website. From the session, it became clear that the current visitor counts would not make it possible to perform the analyses we initially planned to do. We, therefore, concluded that the website needed to be improved. Subsequently, a redesign was initiated. The transnational meeting was also used to create more multimedia clips, in particular, 'video shorts' with all the project members, to generate more attractive content. The revised website tracked visitors.

Figure 13 Final transnational project meeting in Poznan

3. User satisfaction

It was planned to ask every visitor of the website to complete a questionnaire on the first, fifth, and tenth visits concerned with the visitors' experiences with the website, the publications, and the network of teachers and researchers. Given the relatively low visitor count, no relevant use satisfaction information could be obtained. The currently improved website overhaul includes a short satisfaction poll per visit.

Figure 14 Beginning teachers at the University of Southampton working together during phase I

9. Follow Up

9.1 Impact

Within the project, the impact was monitored in two ways.

1. The extent to which the agreed products within the multimedia website, the interactive case studies, and the research outputs were realized by the participating universities.
2. The extent colleagues at other departments of the partner teacher training institutes (e.g. English, Geography) were informed about the interactive case studies and potentially would use the outputs and results. Being well-informed meant being informed in such a way that they make an estimation of whether the materials and approaches are suitable for their domain. With regard to the latter, especially teacher educators, teacher trainers, and researchers in the field of teacher training were interested in our interactive case studies and research results.

Initially, the cases and research results did mainly have an impact on the teacher educators in mathematics and science at the participating universities. After all, they were involved in the creation of both types of products. The combination of concrete materials in the shape of interactive case studies and accompanying research results was convincing for teacher educators and researchers. Teacher educators used the research results to estimate the effect the materials and approaches have in their specific context and adapted them accordingly. Researchers estimated the value of research results on the basis of concrete materials and interactive case studies.

Through the intensive collaboration, the partner organizations learned how to support (student) teachers in implementing evidence-informed teaching practices. Initiating discussions about the relevance of creating an evidence-informed teaching practice and implications for educational development within the organizations, have led to prioritizing this on formal governance agendas. For example, the aim to create an evidence-informed teaching practice is now explicitly mentioned in the strategic plan 2020-2025 of the Faculty of Science & Engineering of the RUG. In addition, at Paderborn University, the RiTE-project had an impact on both the educational and the organizational levels. On the one hand, the courses in the chemistry education department got influenced by the project. Through a lesson study course, the project was even transmitted to schools, which got investigated. On the other hand, the project influenced the local teacher education professional school (Plaz). The project got discussed here and influenced the planning of an annual school-teacher meeting. Each

partner described the impact of the project at the participating institutions and local levels in the report regarding intellectual output 3.

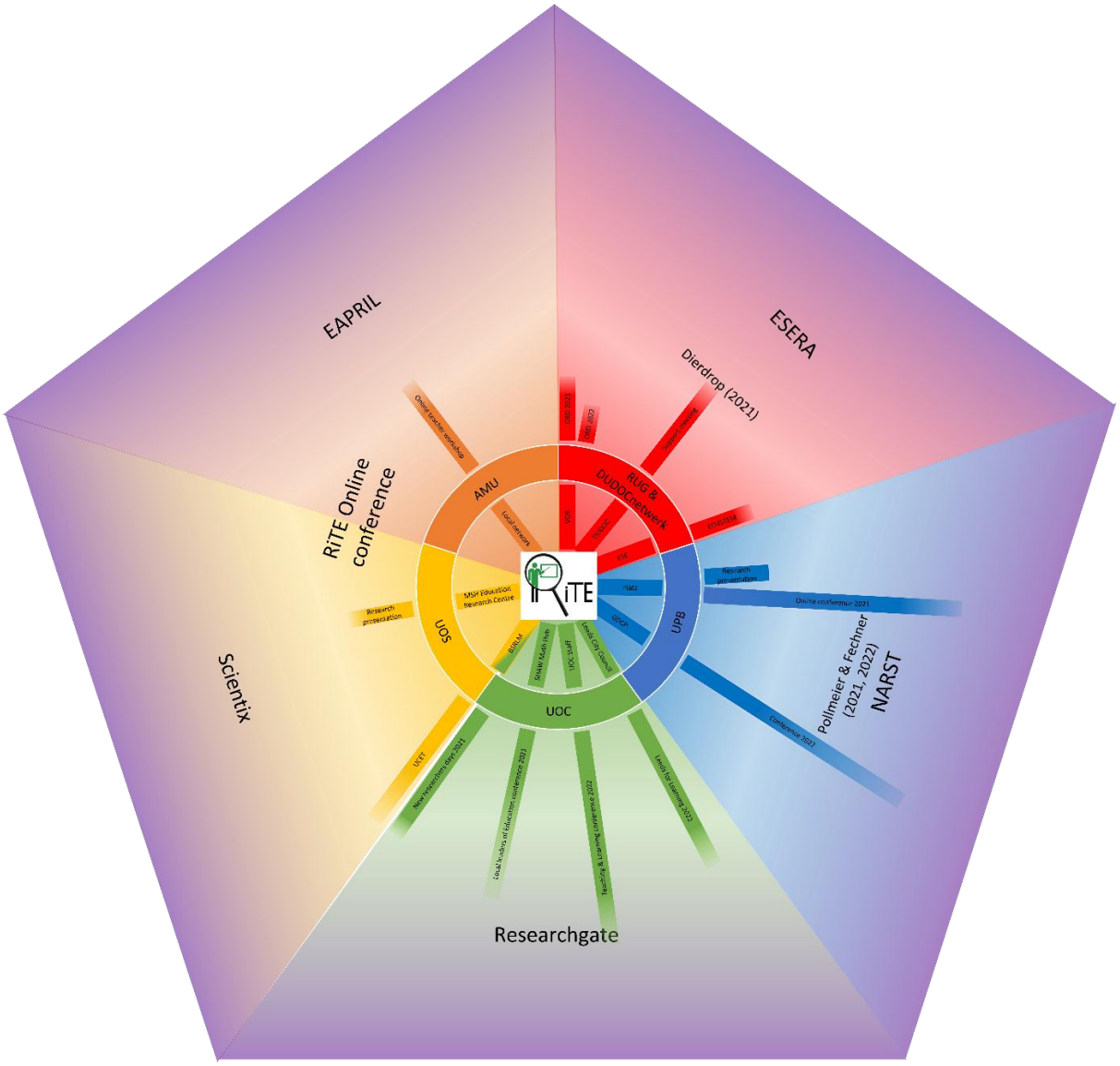

Figure 15 Representation of the impact created by the consortium partners

In phase I of the project, each partner conducts a case study including 10-20 student teachers and 1-3 fellow teacher trainers at the local level (+/- 70 persons in total). Five of the student teachers participated in phase II of the project. Each of the participants teaches about 25-50 students, so indirectly we reached about 1750-3500 students.
The impact of the project was expanded by creating a Support Network along existing national and European networks of teacher educators and researchers. Through the support network that we created, the project had and still has an impact on local, national, and international levels. The network stimulates, facilitates, and supports its members to engage in creating evidence-informed teaching practices.

Figure 16 Organizing a virtual conference for the first time at the Paderborn University using a studio

On a national level, each partner organized support network activities, like teacher workshops (e.g. Poland), contributed to national conferences (e.g. ORD in the Netherlands, BSRLM in the United Kingdom), and organized a virtual conference as multiplier event (Germany). Adding up the number of participants in these support network activities provides a total of 429 people, we, as partners, reached out to directly. Indirectly we reached many more people and institutions that were connected to these participants.

On an international level, we contributed to conferences organized by existing networks like ESERA, EAPRIL, and NARST in order to increase our impact within a European network of educational researchers, developers, teacher trainers, and teachers. Adding up the number of participants in these activities gives us a total of 36 participants in the workshop and round table sessions and 922 attendees to view the ESERA-poster presentation.

To increase the impact, the proposal, conference contributions, papers, and project results were shared on the multimedia website and the online platform of ResearchGate in order to support open online access to the project findings. Adding up the number of reads regarding the products of the project, we reached 1423 views on the 16th of Dec 2022 and the number is still increasing. In addition, open-access articles were published to share the insights developed during the project with the research community.

ResearchgGate.net/project/Research-in-Teacher-Education-RiTE-2

9.2 Dissemination

At the local level, we focused on teacher educators and researchers with whom we work in our own universities and in partner universities. At the regional level, we focused on teacher trainers and researchers who were already united in existing national networks (e.g. BSRLM, VOR, PLAZ).

At the European level, we focused on teacher trainers and researchers who were members of ESERA and EAPRIL. The reason for focusing on teachers, teacher trainers, and researchers in teacher professional development was that the knowledge we acquired is relevant to these groups. After all, the interactive case studies and the acquired insights from the research were derived from courses in teacher training and from insights in the first working year of graduate teachers. The reason we focused on existing networks was that it was possible to elaborate on the problems studied within these networks and to create and maintain a support network in a sustainable way.

The most important added value of our dissemination approach was that it proceeded via existing networks at the national and European levels. By joining these networks we reached many teacher educators and researchers in Europe. The networks also enabled the cooperating universities to meet (online) in this project. Within the existing national and European networks of teacher educators and researchers, the following activities were undertaken that went beyond the partnership. In the national networks, the case study materials and research results were brought to the attention of the network by contributing to their conferences and journals. In the European networks, ESERA and EAPRIL, the conference and journal contributions were stimulated even more strongly because some

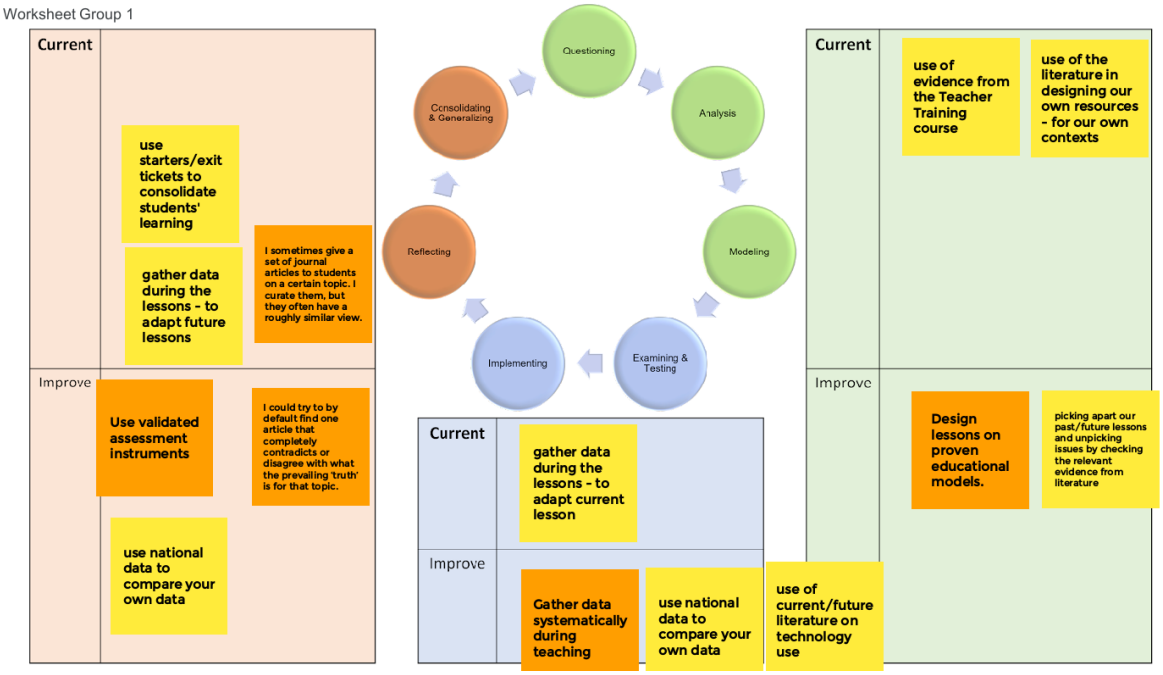

Figure 17 Worksheet presenting the results of the workshop provided during the online conference on 'Research in Teacher Education'

project contacts were active network members. In addition, we organized a multiplier event, and an online conference on 'Research in Teacher Education' to present, share and discuss the results of the project. To increase the impact we used online platforms, like LinkedIn, Scientix, and ResearchGate to share our results and products with an even larger community.

All project outputs were published on the project multimedia website. In addition, all results are available on this digital free, open, and accessible platform ResearchGate.

The partner universities will maintain and develop the courses in their curriculum. As such, the multimedia website will be used and developed continuously. It is therefore that the case studies and research articles will also be kept up to date by the partners. The DUDOCnetwerk, UOS, and UU will not only budget and sustain the multimedia website because of their partnership with the participating universities but also because they benefit from the ongoing development of the case study and research materials. The mission of DUDOCnetwerk states

that they help to bridge the gap between research and practice. Therefore the foundation adopted the aims of this project. In addition, the multimedia website will be hosted by the UOS and UU. In this way, the UOS and UU guarantee the availability of the results, materials, and outcomes after the project.

Figure 18 Recording the webinar in order to present the final results of the project

The outputs of this project are being used by other institutes in the partner countries, also in other domains than STEM. For example, the framework of RUG's ITE-course design, developed during this project, has been adopted by Utrecht University to develop a similar course 'Teacher training for PhDs. The discussions we induced in several workshops and round tables on how to foster evidence-informed teaching practices, continued within the networks we addressed in the project, and as such other institutes in Europe. Going overseas in order to contribute to conferences like the NARST, producing and publishing journal articles, and sharing the results on ResearchGate created an impact on a global level.

9.3 Sustainability

After the EU funding ends the partner universities will maintain and develop the courses in their curriculum. As such, the multimedia website will be used and developed after the project. Therefore the interactive case study materials and research articles will also be kept up-to-date by partners. The DUDOCnetwerk benefits from the ongoing development of case studies and research materials. The partnership that originated through this project has agreed to keep meeting each other in the European network EAPRIL and ESERA and the DUDOCnetwerk has agreed to stay responsible for maintaining and updating the multimedia website after the project end. In addition, the multimedia website will be hosted on the UOS-server under the name of the project coordinator, who works currently at the UU. In this way, the UOS and UU guarantee the availability and sustainability of the results, materials, and outcomes after the project. A fee to purchase the hosting of the website and the materials for at least 5 years after the project has been budgeted as part of the exceptional costs for the DUDOCnetwerk.

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Figure 19 Group picture taken during the final transnational project meeting in Poznan (October

This project responded to two major challenges of our societies on a European dimension:

- the current challenge of evidence-informed decision-making in an age where pieces of evidence are increasingly ignored by policymakers worldwide and the amount of information is increasingly complex;
- the need regarding the strengthening of initial teacher education and continuous professional development.

These challenges were addressed by building a support structure for (future) teachers in science, technology, engineering, and mathematics by educating trainees in implementing evidence-informed practices to improve their teaching and learning processes. The project stimulated a European-wide collaboration between trainees and practitioners to exchange good practices in evidence-informed activities.

The support structure developed consisted of three components

- a multimedia website including five case studies that presented how the teaching and learning trajectories in which evidence-informed practices could be developed;
- a report with the empirically validated support structure and recommendations of teachers and teacher educators about how they managed to maintain their evidence-informed perspective in their teaching practice;
- an European support network of educational researchers, teacher trainers, and teachers in which literature, lesson materials, expertise, and experiences were shared regarding implementing and embedding evidence-informed practices.

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- Adam Mickiewicz University

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