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Research-based learning in teacher education: enhancing reflection skills as a key to perceived usefulness of evidence-informed practice

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Abstract Research-based learning has become important in teacher education with the aim of equipping future teachers with the skills necessary to meet professional challenges. This study explores the extent to which two different seminar formats—one focusing on using research and the other on conducting research—contribute to the development of research skills and the perceived usefulness of evidence-informed teaching practice.

The intervention study involved 295 pre-service teachers in a primary education program. Data were collected through online questionnaires at three points during the semester. The questionnaires measured skills of reflecting on research findings and the perceived usefulness of research for teaching practice. Data were analyzed using 2 × 3 mixed ANOVAs and hierarchical regression.

Results indicate that both seminar formats led to an increase in the ability of pre-service teachers to critically reflect on research findings, but no significant differences between the two formats were found in this regard. However, the perceived usefulness of evidence-informed practice did not significantly improve throughout the seminars. Practical relevance and reflection skills emerged as significant predictors of perceived usefulness while the specific seminar attended did not influence outcomes.

This study underscores the importance of promoting research-based learning and a research-oriented attitude in teacher education to bridge the gap between research

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and practice. The findings suggest that while seminar formats enhance reflection skills, further exploration is needed to determine how to increase the perceived usefulness of research for future teachers. Identifying additional competencies to effectively integrate research into teaching is essential for improving evidence-informed practices.

Keywords Research-based learning · Reflection skills · Perceived usefulness of evidence-informed practice · Teacher education

Forschendes Lernen in der Lehrer*innenbildung: Reflexionskompetenzen als Schlüssel zur wahrgenommenen Nützlichkeit evidenzbasierter Praxis

Zusammenfassung Forschendes Lernen ist ein wichtiges Element in der Lehrer*innenbildung, um angehende Lehrpersonen mit den Fähigkeiten auszustatten, die für die Bewältigung beruflicher Herausforderungen notwendig sind. Diese Studie untersucht, inwiefern zwei unterschiedliche Seminarformate – eines fokussiert die Nutzung von Forschung und das andere die Durchführung von Forschung – zur Entwicklung von Forschungskompetenzen und der wahrgenommenen Nützlichkeit evidenzbasierter Lehrpraxis beitragen.

An der Interventionsstudie nahmen 295 angehende Primarlehrpersonen einer Pädagogischen Hochschule teil. Die Datenerhebung erfolgte durch Online-Fragebögen zu drei Zeitpunkten während des Semesters. Die Fragebögen erfassten die Fähigkeiten zur Reflexion von Forschungsergebnissen sowie die Einschätzung der Nützlichkeit von Forschung für die Unterrichtspraxis. Die Daten wurden mittels zweier 2×3 Mixed ANOVAs und einer multiplen hierarchischen Regressionsanalyse analysiert.

Die Ergebnisse zeigen, dass beide Seminarformate zu einer Steigerung der Fähigkeit führten, Forschungsergebnisse kritisch zu reflektieren, ohne signifikante Unterschiede zwischen den Formaten. Die wahrgenommene Nützlichkeit evidenzbasierter Praxis stieg im Verlauf der Seminare jedoch nicht signifikant. Praktische Relevanz und Reflexionskompetenzen erwiesen sich als signifikante Prädiktoren für die Nützlichkeitseinschätzung, während das besuchte Seminar keinen Einfluss auf die Ergebnisse hatte.

Diese Studie unterstreicht die Bedeutung der Förderung des forschenden Lernens und damit verbunden einer forschungsorientierten Haltung in der Lehrer*innenbildung, um die anhaltende Kluft zwischen Forschung und Unterrichtspraxis zu überbrücken. Die Ergebnisse legen nahe, dass beide Ansätze forschenden Lernens die Reflexionskompetenz stärken, jedoch weitere Untersuchungen erforderlich sind, um herauszufinden, wie die wahrgenommene praktische Relevanz von Forschung für angehende Lehrpersonen gesteigert werden kann. Die Identifizierung weiterer Kompetenzen, die die effektive Integration von Forschung in die Lehrpraxis unterstützen, ist entscheidend für die Verbesserung evidenzbasierter Bildungspraktiken.

Schlüsselwörter Forschendes Lernen · Reflexionskompetenzen · Wahrgenommener Nutzen evidenzinformierter Praxis · Lehrer*innenbildung

1 Introduction

Research-based learning has become an established concept in the higher education landscape of Germany, Austria and Switzerland. Referring to Switzerland, Germany, and Austria (see König and Rothland 2015), whose shared cultural and linguistic context persists despite structural differences in teacher education, the discussion in all three countries centers on the use of scientific evidence in teaching and learning. However, the proposal to integrate research competences into teacher education is not without controversy. Critics argue that both pre-service teachers and educators often perceive research-related learning content as too detached from practical problem-solving situations (Stelter and Miethe 2019). Pre-service teachers without research competences lack the foundation for critically engaging with school practice and acquiring new perspectives. As a result, the link between reflection and research is lost (Hummrich 2019). Following Böttcher and Thiel (2018), research competences can be understood as an overarching construct that integrates both knowledge and skills; in this study, we focus on the skills dimension as the concrete, learnable abilities that enable pre-service teachers to engage with and reflect on research. By equipping future teachers with the skills to engage in and reflect on research (Böttcher and Thiel 2018), it is expected that they will be better prepared for their profession and its challenges: "In the twenty-first century context there is a need for teacher education to be proactive in generating self-reflective teachers with the capacity to shape classrooms and schools to meet changing needs" (Brew and Saunders 2020, p. 10). In this regard, two demands are being imposed on teachers: they are expected to use empirical evidence (Bauer et al. 2015; Seidel et al. 2020) and data-based feedback to improve teaching and school effectiveness (Schildkamp 2019; Schildkamp et al. 2019). Brown et al. (2017) combine both demands under the concept of "Evidence-Informed School and Teacher Improvement", positing that educational decisions become more equitable, effective, and efficient when integrating professional judgment, empirical research, and school-based data. This approach requires two sets of skills: evaluating existing research to apply its findings (*use research*), and employing research methods to *establish research* (Herzmann and Liegmann 2018, p. 75).

However, studies show that pre-service teachers view research rather critically or at least express mixed views on it (Nägel et al. 2023; Van Katwijk et al. 2019). Although both pre-service and in-service teachers acknowledge the relevance of theoretical knowledge and research (Nägel et al. 2023; Van Katwijk et al. 2019), teachers do not apply them in future practice (Van Katwijk et al. 2019) and they play little role in actual teaching and school practice (Dedering and Kallenbach 2023; Hinzke et al. 2020). This may be partly attributed to pre-service teachers' perceptions of the limited usefulness of educational theories and evidence (Kiemer and Kollar 2021). However, these perceptions can shift when they experience the

link between research and practice (Bleck and Lipowsky 2020) and perceive its relevance to their practice.

While the relevance of skills for reviewing empirical evidence and for employing research methods has been widely acknowledged in teacher education (Herzmann and Liegmann 2018), a third key skill set has so far received considerably less attention: research reflection skills, that is, the ability to reflect on research findings by considering their implications, methodological limitations, practical relevance and ethical aspects (Böttcher and Thiel 2018). Such skills may be particularly important for connecting research and practice as they may enable prospective teachers to derive actionable insights from empirical findings (Bleck and Lipowsky 2020). Despite their potential relevance, it remains unclear how teacher education can foster research reflection skills, and whether and how these skills are related to a positive perception of the usefulness of evidence-informed practice (Brown et al. 2017).

This study explores which set of skills—research review skills, focused on using existing research, or methodological skills, centered on establishing research—is more effective in fostering pre-service teachers' ability to reflect on research findings. This study investigates how pre-service teachers engage with evidence-informed practice through participation in two distinct types of research-based seminars: one focused on *using* existing research and the other on *establishing* original research (Davies 1999). Specifically, it examines whether and how participants' perceptions of the usefulness of evidence-informed practice evolve over the course of these seminars, and whether differences emerge between the two formats. Furthermore, the study explores whether skills in reflecting on research findings along with the perceived relevance of the seminar content to teaching practice, serve as predictors of how useful participants ultimately perceive evidence-informed practice to be.

2 Conceptual framework: research-based learning in teacher education

Teachers often analyze challenging classroom situations based on intuition or experiential knowledge rather than on educational theories and empirical evidence (Csanadi et al. 2021; Hetmanek et al. 2015). Similarly, pre-service teachers show a more positive attitude towards anecdotal evidence than towards educational research (Bråten and Ferguson 2015; Kiemer and Kollar 2021). To overcome the limitations of relying on a single source, evidence-informed practice integrates multiple sources, enabling holistic and contextually relevant decision-making (Vanlommel and van den Boom-Muilenburg 2024).

In research-based learning, the integration of diverse sources of evidence plays a central role. Three primary sources of evidence emerge from the literature: experience, findings from research, and findings from data. Experience-based evidence encompasses the expertise or personal knowledge professionals accumulate through practice, often tacit and context-specific (Bauer and Kollar 2023; Vanlommel and van den Boom-Muilenburg 2024). Research findings derived from systematically collected and rigorously evaluated studies provide generalizable insights for improving practice (Brown et al. 2016). Data-based evidence, such as pupil assessment results, offers contextualized information to tailor interventions (Brown et al.

2017). In order to utilize all sources of evidence appropriately in response to the challenges of school practice, it is essential to equip teachers with the necessary skills to critically assess the differential reliability of various sources of evidence and other available information (Bauer and Kollar 2023; Heininger 2019; Trempler et al. 2015).

We follow Böttcher and Thiel's (2018, p. 95) understanding and define research competences as "cognitive dispositions which are (a) acquired by learning in university courses, (b) applied in the context of carrying out the research process, and (c) needed to successfully cope with tasks arising from research-oriented teaching arrangements". Within their overarching competence framework, the authors specify four key research skill sets:

1. Reviewing research skills: analyzing literature, identifying contradictions, and spotting gaps
2. Methodological skills: formulating questions, operationalizing, and conducting research with appropriate methods
3. Reflection skills: evaluating findings in terms of implications, limitations, relevance, and ethics
4. Communication skills: writing publications and presenting results

For evidence-informed school and teacher improvement, the first three skill sets are particularly crucial while communication skills are comparatively less essential as teachers do not need to disseminate results in academic contexts. Reviewing research is crucial for utilizing research findings while methodological skills are key for conducting research and analyzing empirical data. Reflection skills help teachers to derive actionable insights, thus fostering research-informed teaching and data-informed decision-making, which, in turn, can contribute to evidence-informed school and teacher improvement. In this study, we use *research skills* as an overarching term that comprises the three specific skill domains under investigation: reviewing skills, methodological skills, and reflection skills.

To apply these skills, teachers must also believe in their usefulness. Yet, literature shows that teachers question the ecological validity of educational research and, consequently, the generalizability of its findings to their heterogeneous and dynamic classrooms (Joram et al. 2020). This skepticism is further reinforced by the probabilistic nature of research results: no study can guarantee that a particular intervention will be effective in a specific teaching context. As a result, teachers may be reluctant to invest time and effort in implementing innovative practices that require replacing well-established routines, especially when their success is uncertain (see also Nägel et al. 2023). Teachers also report difficulty applying research findings in practice (Hetmanek et al. 2023). This underscores the necessity for (pre-service) teachers to develop skills that enable them to critically "reflect on the limitations as well as on the theoretical, ethical, and practical implications of research" (Böttcher and Thiel 2018, p. 94). Furthermore, it becomes apparent that teachers who acknowledge the benefits of research, receive the necessary support from their colleagues and perceive research as a characteristic of successful teachers and schools are more likely to utilize it for the advancement of teaching and school improvement (Brown

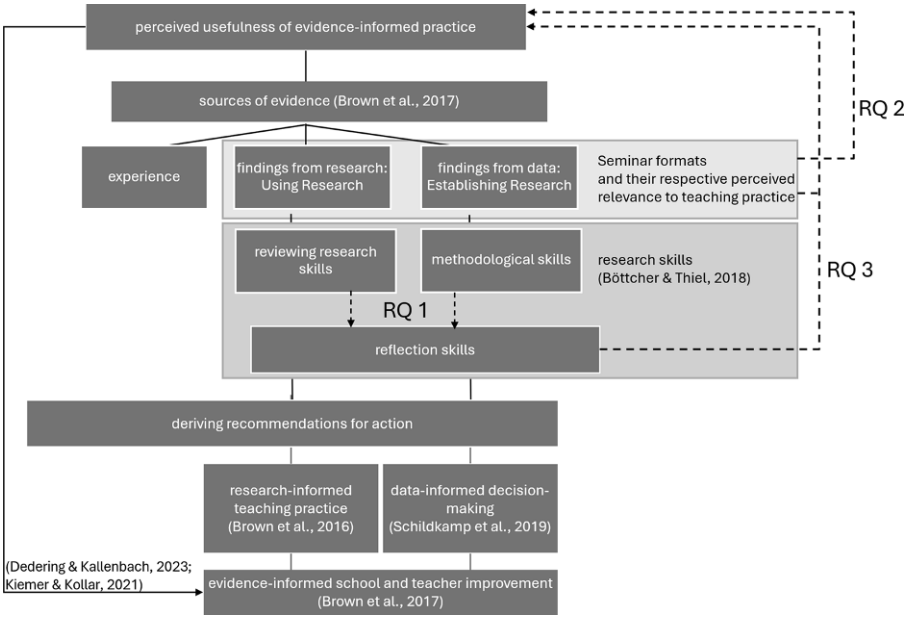

Fig. 1 Conceptual framework

et al. 2022). The perceived usefulness of research for practice depends significantly on teachers' skills and available time for reviewing research (Thomm et al. 2021). If, in addition to skills, the perceived relevance of empirical findings for teaching practice also predicts the use of research, the need is underscored to foster a research-oriented, evidence-based professional mindset during teacher training (Dedering and Kallenbach 2023; Kiemer and Kollar 2021).

The integration of the key research skills (Böttcher and Thiel 2018) into the framework of evidence-informed school and teacher improvement (Brown et al. 2017) provides guidance on which skill sets enable pre-service teachers to engage in specific evidence-informed school development activities. The addition of the perceived usefulness of evidence-informed practice offers a theoretical framework to better analyze and potentially explain the exclusion of scientific evidence by teachers (see Fig. 1).

3 Teaching formats for the development of research competences: overview and state of research

Given the growing emphasis on evidence-informed practice, several teaching formats have been designed to help pre-service teachers acquire skills to use and establish research. This section provides an overview of selected teaching formats that aim to foster research competences, with particular attention to their conceptual foundations, their implementation in teacher education programs and insights from empirical studies on their effectiveness.

Research-Learning Projects (e.g. Böttcher-Oschmann et al. 2021) aim to equip pre-service teachers with the necessary skills for both using and establishing research. Students independently engage in all phases of the research process, deepening their understanding of how research methods and findings apply to educational settings. Instructors support the process by providing guidance, addressing challenges and encouraging collaboration. A longitudinal study (Böttcher-Oschmann et al. 2021) found significant gains in research competence, especially in reviewing literature, applying methods and communicating results, all based on self-assessments and standardized tests.

Service learning combines community service with academic learning, enabling students to address real-world challenges while connecting to their curriculum (Mutambara 2023). In teacher education, pre-service teachers take on school-related issues through research projects, gaining methodological skills and insight into how research informs practice and how to derive actionable insights (Froehlich et al. 2021). While service learning helps to foster a deeper understanding of the connection between theory and practice, it also exposes pre-service teachers to the complexity of real-world challenges. However, the problems defined in such projects dictate the required skills, making systematic skill acquisition difficult. A study by Resch and Schrittesser (2021) focused on service learning in teacher education finds that it is an effective way to bridge the gap between theory and practice by fostering critical reflection and it helps students prepare for their future professional roles. Similarly, the study by Mergler et al. (2017) provides evidence that service learning has a positive effect on pre-service teachers. These findings underscore the transformative potential of service learning in preparing pre-service teachers for the complex realities of inclusive and socially responsive education.

Action research in teacher education is a cyclical, reflective process that helps pre-service teachers systematically improve their practices. It involves identifying challenges, reflecting on them, planning and implementing changes based on empirical findings and critically evaluating the outcomes (Ferencová et al. 2024; James and Augustin 2018). In German-speaking countries, for example, Heissenberger and Matischek-Jauk (2020) describe an action research project in which theory, research and practice are integrated in teacher education. Supervisors provide a framework that supports development, reflection and academic grounding while research activities are implemented in practical school settings. Empirical findings show that action research fosters pedagogical content knowledge, reflective practice, collaboration and research-based intervention. It also enhances motivation, self-efficacy and a growth mindset (Ferencová et al. 2024). Challenges include time demands and the need for a supportive environment (James and Augustin 2018), but the potential for improving teaching quality and student learning is well documented.

In research learning projects problems arise from the literature review, while in service learning, problems derive from practice. The starting point for action research is the pre-service teacher's own experience or observed challenges in educational settings. However, in all three learning formats, pre-service teachers are expected to carry out their research projects in a practical context. Research-based learning formats have been shown to enhance nearly all areas of research competences among pre-service teachers, except for interpreting evidence and drawing practice-relevant

conclusions (Böttcher-Oschmann et al. 2021, p. 8). However, such formats do not necessarily increase interest in research itself (Sonntag and Pruess 2018, as cited in Lehmann and Mieg 2018). Reuter and Leuchter (2023) found that higher self-perceived research skills and knowledge are associated with a greater likelihood of developing a scientific orientation, regardless of initial beliefs. These findings suggest that the experience of having skills may be particularly important as it increases the likelihood that pre-service teachers will engage in evidence-informed practice.

4 Research gap, research questions and hypotheses

While teaching and learning concepts for developing research competences have been evaluated internationally (Filderman et al. 2021; Kippers et al. 2018; Puustinen et al. 2018; van der Linden et al. 2015; Van Katwijk et al. 2019), few studies exist for Germany (Böttcher-Oschmann et al. 2021; Csanadi et al. 2021; Hetmanek et al. 2023) and Austria (Froehlich et al. 2021; Heissenberger and Matischek-Jauk 2020), and, to the authors' knowledge, none for Switzerland. Considering the employment of seminar formats with a separate focus on using research rather than on establishing research enables a more nuanced understanding of the specific skills fostered by each approach. It also provides a basis for analyzing the differential effects of each format on pre-service teachers' skills in reflecting on research and how the usefulness of evidence-informed practice is perceived. Since perceived usefulness is key to successful implementation, as highlighted in the framework, identifying its predictors is essential. This leads to the following research questions:

RQ 1 Which seminar format—'Using research' or 'Establishing research'—is more effective in developing skills in reflecting on research findings?

RQ 2 Does the perceived usefulness of evidence-informed practice evolve during participation in one of the seminars? Are there differences between the two seminar formats?

RQ 3 To what extent does the increase in perceived reflection skills predict post-seminar perceived usefulness of evidence-informed practice, after controlling for baseline perceived usefulness, the attended seminar type, and perceived relevance to teaching practice?

5 Method

5.1 Study context and sample

This study investigated how pre-service teachers in two primary education courses at FHNW School of Education developed research skills and their perceptions of the courses' relevance for teaching practice and of evidence-informed practice in

general. The learning format described in this study comprises two seminars, emphasizing either *using research* or *establishing research* in the primary education program—designed and implemented within the curricular constraints of the primary education program. They are linked by the profession-relevant topic of learning support. The seminar on Using Research focused on the practical application of research. In small groups, students analyzed a research paper, summarized its central insights, and formulated teaching recommendations based on the main findings. In contrast, the seminar on Establishing Research emphasized the generation of empirical evidence. Students evaluated the learning environment of the Using Research seminar, making it the actual focus of their research. This included translating theoretical considerations into a research design, planning and conducting a scientific survey, preparing data, analyzing descriptive quantitative data, and interpreting inferential statistical results. The learning format blends service learning and research-based learning within teacher education. Like service learning, it engages students with realistic classroom scenarios via video vignettes, connecting theory to practice. Unlike traditional service learning, it remains within higher education and emphasizes guided reflection and inquiry. Aligned with research-based learning, it promotes critical thinking, evidence-informed reasoning, and active research engagement, distinguishing between using research (applying existing findings) and establishing research (conducting empirical inquiries).

Each seminar lasted one semester. Data from pre-service teachers across three cohorts were included. A total of 295 pre-service teachers enrolled in either Seminar 1 or Seminar 2 and were invited to participate in voluntary online surveys at three measurement points. Response rates varied across the time points (Seminar 1: $N_{t1} = 101$, $N_{t2} = 98$, $N_{t3} = 75$; Seminar 2: $N_{t1} = 142$, $N_{t2} = 131$, $N_{t3} = 115$), which is typical in voluntary survey designs. The majority of the pre-service teachers were female (76%).

5.2 Data collection and instruments

Data was gathered via an online questionnaire at three time points: before the seminar (t1), near the end of the seminar (t2) and after the seminar (t3). The questionnaire included scales on pre-service teachers' skills in reflecting on research as well as how they perceived the usefulness to teaching practice and the perceived relevance of such skills to teaching practice. Research skills were measured by R-Comp (Böttcher and Thiel 2018) using a 5-point Likert scale ranging from 1 (does not apply at all) to 5 (fully applies). We employed self-report measures to assess reflection skills in order to minimize participant burden, as implementing a performance-based assessment could have increased dropout rates. Skills in reviewing the state of research were measured by four items (e.g. *I am able to review and systematically summarize the state of research on a specific topic;* $\alpha_{t1} = 0.78$, $\alpha_{t2} = 0.71$). Methodological skills were measured by eight items (e.g. *I am able to plan a research process;* $\alpha_{t1} = 0.77$, $\alpha_{t2} = 0.66$, $\alpha_{t3} = 0.76$). Skills in reflecting on research findings were measured by six items (e.g. *I am able to discuss my research results with regard to their application potential;* $\alpha_{t1} = 0.81$, $\alpha_{t2} = 0.80$, $\alpha_{t3} = 0.81$).

Table 1 Summary of descriptive statistics for scales and samples included in the analysis

			t1		t2		t3	
		N	Mean	SD	Mean	SD	Mean	SD
Skills in reflecting on research	Seminar 1	40	3.45	0.58	3.60	0.50	3.66	0.44
	Seminar 2	67	3.39	0.57	3.49	0.63	3.67	0.53
	Total	107	3.41	0.57	3.53	0.58	3.66	0.50
Perceived usefulness of evidence-informed practice	Seminar 1	38	4.20	0.63	4.25	0.50	4.19	0.56
	Seminar 2	66	4.22	0.57	4.23	0.59	4.27	0.65
	Total	104	4.21	0.59	4.24	0.55	4.24	0.61
Perceived relevance to teaching practice	Seminar 1	37	–	–	4.04	0.69	–	–
	Seminar 2	62	–	–	3.78	0.76	–	–
	Total	99	–	–	3.88	0.74	–	–
Reviewing research skills	Seminar 1	63	3.23	0.62	3.60	0.49	–	–
Methodological skills	Seminar 2	67	3.09	0.45	3.30	0.38	–	–

Seminar 1 focused on *Using research* while Seminar 2 emphasized *Establishing research; cases with missing data on a given variable were excluded only for that variable*

The instrument *perceived usefulness of evidence-informed practice* (Saunders et al. 2020) consists of six items (e.g. *Trying out and investigating new things in classroom practice enables teachers to act flexibly in unexpected situations*.). The response scale ranged from 1 (disagree) to 5 (agree). This scale showed very good reliability ($\alpha_{t1} = 0.85$, $\alpha_{t2} = 0.80$, $\alpha_{t3} = 0.87$).

The scale for *perceived relevance to teaching practice* comes from the School of Teacher Education's teaching evaluation form and consists of 3 items (e.g. *The course is important for my future professional practice*; $\alpha_{t2} = 0.77$). The response scale ranged from 1 (does not apply at all) to 5 (fully applies).

5.3 Data analysis

To address RQ1 and RQ2, two 2 × 3 mixed ANOVAs were conducted, with the attended course as the between-group factor and the three data collection points as the within-group factor. To avoid potential violations of the sphericity assumption, only multivariate F-statistics are reported. To answer RQ3, a multiple hierarchical regression analysis was conducted after confirming that all key assumptions were met.

6 Results

The results section presents descriptive analyses, the manipulation checks for the two seminar formats, and analyses of the three research questions. Table 1 displays the descriptive statistics for the scales used in the study.

As expected, attendance at each seminar led to a significant increase in participants' self-reported targeted skills (Reviewing research skills in Seminar 1 $t(62) = -5.03$, $p < 0.001$, $d_z = -0.63$; Methodological skills in Seminar 2 $t(66) = -3.37$, $p = 0.001$, $d_z = -0.41$). This confirms that the intervention design functioned as intended.

For the **RQ 1**, results showed that while the interaction effect ($F_{multivariat}(2,104) = 0.83$, $p = 0.440$, Wilk's Lambda = 0.98) and the between-subjects effect were not significant ($F(1,105) = 0.32$, $p = 0.576$), a significant within-subjects effect was found $F_{multivariat}(2,104) = 9.17$, $p < 0.001$, Wilk's Lambda = 0.85. While the increase in the subjective skills in reflecting on research from t1 to t2 is still negligible ($d_z = 0.17$), it can be described as small from t2 to t3 ($d_z = 0.27$) and from t1 to t3 ($d_z = 0.41$). The respective levels of both skills at the end of the seminar (t2) show significant and medium correlations with skills in reflecting on research after the seminar (t3), with $r = 0.35$ ($p = 0.003$) for methodological skills and $r = 0.42$ ($p = 0.001$) for skills in reviewing the state of research. The two correlations do not differ significantly ($p = 0.328$).

Regarding **RQ 2,** none of the three effects examined was significant: The perceived usefulness of evidence-informed practice did not evolve during participation in one of the seminars ($F_{multivariat}(2,101) = 0.13$, $p = 0.879$, Wilk's Lambda = 0.997) and no differences could be found between the two ($F(1,102) = 0.07$, $p = 0.795$). The interaction effect also remains non-significant ($F_{multivariat}(2,101) = 0.51$, $p = 0.605$, Wilk's Lambda = 0.990).

Table 2 Hierarchical multiple regression analysis of perceived usefulness of evidence-informed practice t3

	Model 1				Model 2			
Predictor Variables	b	SE	β	*p*	b	SE	β	*p*
Perceived usefulness of evidence-informed practice t1	0.44	0.10	0.41	<0.001	0.45	0.09	0.43	<0.001
Increase in skills in reflecting on research t1 to t3	–	–	–	–	0.33	0.09	0.34	<0.001
Attended seminar (using vs. establishing research; establishing research = 0)	–	–	–	–	–0.05	0.11	–0.04	0.670
Perceived relevance of the seminar to teaching practice t2	–	–	–	–	0.15	0.07	0.19	0.039
Model	–				Change statistics: $\Delta R^2 = 0.17$, $\Delta F(3,94) = 8.03$, $p < 0.001$			
	Model 1: $R^2 = 0.17$; $F(1,97) = 19.78$, $p < 0.001$				Model 2: $R^2 = 0.34$, $F(4,94) = 12.04$, $p < 0.001$			

For **RQ 3**, in the first step of the multiple hierarchical regression, the perceived usefulness of evidence-informed practice at t1 was entered and explained 17% of the variance in the same variable at t3, $F(1,97) = 19.78$, $p < 0.001$. Beyond perceived usefulness of evidence-informed practice at t1, the attended seminar (using vs. establishing research), the increase in perceived reflecting skills and the perceived relevance to teaching practice explained an additional 17%, which is a significant change, $\Delta F(3,94) = 8.03$, $p < 0.001$. The overall model explained 34% of the variance, $F(4,94) = 12.04$, $p < 0.001$. Significant predictors were perceived usefulness of evidence-informed practice at t1, the increase in perceived reflection skills from t1 to t3 and perceived relevance to teaching practice (see Table 2).

For the significant predictors, there is only one significant group difference between students of the two courses offered, namely for perceived relevance to teaching practice t1, $t(211) = -3.06$, $p = 0.002$, $d = 0.42$. Pre-service teachers experience the course that addresses using research as of more practical benefit than the course that addresses establishing research.

7 Discussion

Aligned with Brown et al. (2017) approach of evidence-informed practice, the study reveals that both courses (using and establishing research) significantly improve reflection skills. It remains unclear whether combining both courses amplifies the effect. Reflective skills—understood as the ability to critically engage with research findings and derive potential courses of action (Böttcher and Thiel 2018)—are essential for bridging the gap between research and classroom practice. While our findings suggest that reflective skills show slight improvement regardless of whether students are taught reviewing or methodological skills, their substantial association with the targeted research skills—namely, using vs. establishing research—suggests that these foundational skills may provide an important basis for developing the ability to reflect critically on research. However, meaningful reflection, especially on practical, methodological and ethical aspects, requires targeted instruction beyond general research-based learning. In this regard, skills in reflecting on research may be viewed not only as a product of research engagement but as a distinct skill set necessary for fostering evidence-informed decision-making and practice. The capacity to derive practical implications from research is particularly crucial for enabling teachers to act on evidence in complex school settings. Future research should therefore focus on developing targeted interventions to support this aspect of professional learning. Promising approaches situated in the school context and addressing either the use of research or the use of data, such as research-informed teaching practice in research learning communities (Brown 2017) or data-based decision-making in data teams (Schildkamp et al. 2019), provide initial insights into how such reflective processes can be effectively cultivated in teacher education and school development contexts. There are already conceptual considerations for combining both approaches (Brown et al. 2017). However, concrete suggestions for practical interventions appear to be limited in Switzerland, and, as in many higher education systems, universities' curricular requirements may constrain the range of feasible

actions. No change in the perceived usefulness of evidence-informed practice was observed during the seminars. The teaching of reviewing and methodological skills alone does not increase the understanding of their usefulness, but an improvement in the skill of reflection—an advanced research skill—significantly predicts the perceived usefulness after each course. Moreover, an increase in reflective skills is associated with a higher perceived usefulness of evidence-informed practice. In the present study, the lack of change in perceived usefulness aligns with similar previous findings, suggesting that research-based learning formats do not necessarily increase interest in research itself (Sonntag and Pruess 2018, as cited in Lehmann and Mieg 2018). Earlier studies have shown that a perceived lack of skill and time to access and understand research findings substantially contributes to the perception that research is irrelevant (Thomm et al. 2021). Although skill development may help overcome these barriers, our findings suggest that instruction alone does not shift attitudes. This highlights the importance of not only developing skills but also of providing opportunities for meaningful application and reflection to foster perceived usefulness and relevance. Our results indicate that reflection plays a central role in increasing perceived usefulness. These more advanced skills, such as the ability to derive practical implications from research, appear to play a more critical role. This suggests that successful experiences in translating research findings or data into actionable classroom practices may foster more positive attitudes toward evidence-informed teaching. Furthermore, increased reflective skills emerged as a stronger predictor of perceived usefulness than the perceived relevance of the seminar for future professional practice. Notably, the best predictor of perceived usefulness at t3 was the initial rating at t1, emphasizing the persistence of initial attitudes and the need for sustained, targeted interventions to bring about meaningful change.

However, several limitations should be considered. First, the longitudinal design covers only one semester. Research competences are addressed in various courses throughout teacher education, and a longer-term perspective covering the full program would provide deeper insights into developmental trajectories. Second, while all participants were enrolled in the same research seminars, they experienced differing additional learning environments during the semester, making differential effects possible. Third, dropout rates were relatively high, which may have introduced sample bias and affected the generalizability of the findings. Finally, it should be noted that research skills were measured solely via self-report. While this approach provides insight into students' subjective perceptions, it does not allow for conclusions regarding actual skill development. Future research should complement self-reports with objective assessments to determine whether the observed changes correspond to measurable improvements in research competencies. Building on this, studies could also aim to capture the development of research skills over a longer period and across multiple educational contexts. Promising models such as data teams or research learning communities may offer valuable frameworks for cultivating evidence-informed professionalism in both pre-service and in-service teacher development.

8 Conclusion

The findings of this study contribute to a more nuanced understanding of how prospective teachers engage with evidence-informed practice. While research learning formats often focus on developing methodological and/or reviewing skills, our results indicate that these skills alone may not necessarily foster positive attitudes toward research usefulness.

Instead, reflection, particularly the ability to derive practical implications from research, emerged as key. Increases in these advanced skills were significantly associated with perceived usefulness, suggesting that meaningful application and reflective engagement are central to fostering a research-informed professional stance.

This insight has important implications for the design of teacher education and professional learning programs. It underscores the need to go beyond technical training and include structured opportunities for reflection, practical translation and collaborative inquiry. While the persistence of initial attitudes points to the challenge of altering deep-seated beliefs, it also highlights the potential of targeted, reflective interventions to gradually shift teachers' engagement with research.

In the broader discussion about the significant gap between research and practice, one key reason often cited is that researchers and practitioners belong to remarkably different communities with different contexts, cultures, structures and purposes (Farley-Ripple et al. 2018). Consequently, the question arises of how these two communities can come closer together to bridge this gap and work productively in an interactive space (Coburn and Stein 2010). It remains to be determined which additional skills in-service teachers must have so as to be able to participate in the interactive space and how these can be taught in teacher education, thereby reducing the often expressed skepticism about the applicability of scientific theory and empirical findings.

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