

ARTICLE

Using the theory of planned behaviour to predict pre-service teachers' preferences for scientific sources

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Abstract

Background: Despite the growing emphasis on research-based teacher education and calls for evidence-informed practice, teachers tend to prefer experiential over scientific knowledge sources to inform their actions, justify decisions and analyse educational problems. This tendency already occurs as early as during initial teacher education, and it is possibly bolstered by school internships where mentors emphasise the value of practical over scientific knowledge.

Aims: The present study applied the theory of planned behaviour (TPB) to investigate under what conditions pre-service teachers intend to use and prefer scientific sources from educational research.

Methods: The study's participants were 343 pre-service teachers in a half-year school internship who indicated their attitudes towards educational research, behavioural control (i.e. self-efficacy), perceived subjective norm, intentions of using research and preference for scientific sources in a survey. Perceived subjective norm was established by measuring whether pre-service teachers believed their mentors considered research-based knowledge.

Results: In line with the predictions of the standard TPB model, structural equation modelling confirmed the effects of positive attitudes, self-efficacy and perceived subjective norm on pre-service teachers' intentions of using research. In turn, intentions and self-efficacy predicted preferences for scientific sources but not the use of scientific sources when planning a lesson in the internship.

Conclusions: Pre-service teachers' scientific source preferences are shaped not only by personal dispositions but also by the social context of school.

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KEYWORDS

evidence-informed practice, research reception, school internships, source preferences, teacher education, theory of planned behaviour

INTRODUCTION

Equipping future teachers with research-based knowledge for their professional practice is the major purpose of initial teacher education (Darling-Hammond & Bransford, 2005; European Commission, 2007). There is growing consensus among policymakers and teacher educators that teaching should be a research-based profession which shall rely on research knowledge rather than merely on intuition, ideology, conventional wisdom and personal preferences (e.g. Bauer & Prenzel, 2012; Brown & Zhang, 2016; Organization for Economic Cooperation and Development, 2005). Research-based knowledge, for example, can provide information to enrich, explain and justify professional actions and judgements as well as promote critical reflection on one's practice (Thomm, Sälzer, et al., 2021). Evidence suggests that teachers with higher levels of professional knowledge provide higher quality instruction and yield better student outcomes (e.g. Baumert et al., 2010). Cultivating high professional competence requires, on the one hand, acquiring substantial and well-structured domain-specific knowledge and, on the other hand, integrating and enriching it with meaningful professional experience (Baumert et al., 2010). This mindful integration of scientific knowledge and professional experience reverberates in conceptions of evidence-informed practice (Bauer & Kollar, 2023; Rousseau & Gunia, 2016).

However, despite these developments, research shows that teachers hardly draw upon educational research; instead, they often base their practice and decisions on experience and tradition (e.g. van Schaik et al., 2018). The reasons for this are manifold, ranging from fundamental differences in the nature of scientific and practical knowledge, lack of skills, dysfunctional attitudes and motivational orientations to quite tangible barriers, such as a lack of time to engage with research and insufficient access to relevant sources (Thomm, Seifried, & Bauer, 2021).

Reducing these barriers requires laying the foundations of competent research reception and use during initial teacher education (Bauer & Prenzel, 2012). Recent survey and intervention studies have started to examine pre-service teachers' skills and willingness (i.e. attitudinal and motivational dispositions) to engage with and use educational research (e.g. Böttcher-Oschmann et al., 2021; Nägel et al., 2023). However, these efforts are moot when experiences in school internships leave pre-service teachers with the impression that research-based knowledge is irrelevant to teachers' work. Sometimes, practicum mentors devalue, explicitly or implicitly, the research-based ideas that pre-service teachers bring to schools (Hascher et al., 2004; Hobson et al., 2009). These experiences of models of active teaching create a subjective norm that may shape pre-service teachers' intentions to engage with educational research. This influence operates in addition to that of individual attitudes and skills.

Despite an increasing number of relevant studies, we still need to improve our knowledge of the predictors that potentially foster pre-service teachers' intentions and preferences for using scientific information sources when analysing school-related problems, justifying decisions and planning lessons. The present study aimed to contribute to this field by applying the theory of planned behaviour (TPB; Ajzen, 1991, 2020) to model pre-service teachers' intentions to use research-based knowledge as well as their preferences for and actual use of scientific sources. First, we examined whether the TPB model was suitable to explain pre-service teachers' intentions and preferences for using scientific sources to inform themselves about school-related issues as well as their source use in planning a lesson during an internship. Second, given the supposedly important role of mentors in school internships, we were specifically interested in the relative impact of this subjective norm compared to individual dispositions.

Using the TPB to model pre-service teachers' intentions to use research, scientific source preferences and source use

The TPB provides a well-established and widely accepted framework for explaining how individual attitudes, motivational orientations and perceived social context influence individual behaviour (Ajzen, 1991, 2020; Armitage & Conner, 2001). Applications to educational research have highlighted the TPB's explanatory power (e.g. MacFarlane & Woolfson, 2013). So far, however, very few TPB studies have been conducted on educational research reception and use (Greisel et al., 2023; Nägel et al., 2023), even though Rousseau and Gunia (2016) highlighted the theory's potential for investigating the conditions that drive teachers' endorsement of evidence-informed practice.

The classic TPB model contains the following hypotheses (see Figure 1). First, planned behaviour depends directly on behavioural intentions. Second, these intentions are a function of three types of individual beliefs: (i) *attitudes* towards the behaviour, which entail the expectancy and the value of behavioural outcomes; (ii) *subjective norms*, which consist of the belief that relevant others expect and endorse the behaviour and (iii) *perceived behavioural control*, which refers to a person's belief that they are capable of performing the target behaviour. This implies that these beliefs are *indirect* predictors of behaviour via their influence on intentions. Furthermore, perceived behavioural control can also influence the target behaviour *directly*.

Applying the TPB to the context of evidence-informed practice (see Figure 1), we expect teachers to be more likely to prefer and use scientific sources if they intend to do so. This intention should be stronger if teachers have (i) favourable attitudes and (ii) positive control beliefs regarding the search and use of scientific sources and if they perceive (iii) social pressure from relevant others in their social context (for pre-service teachers, their mentors in school internships). These assumptions imply the indirect effects mentioned above. In the following sections, we elaborate on these assumed relationships.

Behavioural aspects: Scientific source preferences and use

Sourcing activities (e.g. source evaluation, selection and use) build the basis for future teachers to consult educational research knowledge; therefore, they are at the centre of evidence-informed teaching practice (Duke & Ward, 2009; Thomm, Seifried, & Bauer, 2021). Specifically, source preferences are crucial because they represent the kind of information that a person tends to choose to become informed about a specific topic. Hence, source preferences can determine whether sources of research-based knowledge are considered at all. In general, pre-service teachers can consult various types of sources to retrieve information concerning educational issues. However, prior research

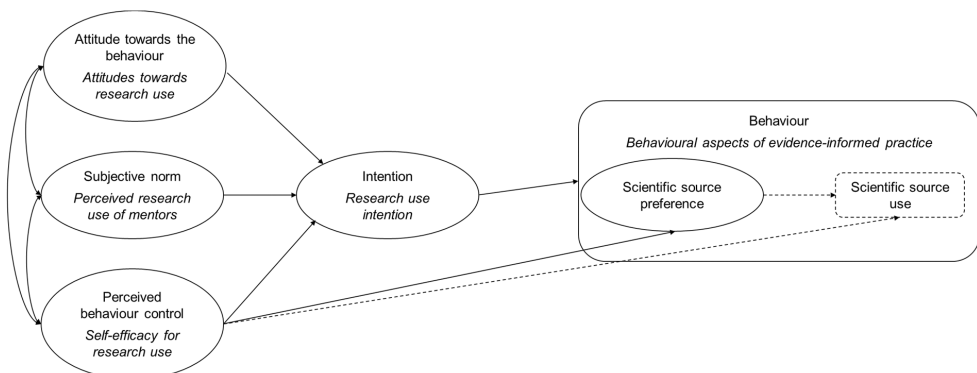


FIGURE 1 Theoretical model of the theory of planned behaviour (TPB) applied to the context of evidence-informed practice. The solid lines show the original TPB model; the dashed lines illustrate our extension of the TPB model.

shows that they exhibit a strong preference for experiential sources, such as personal episodes or reports from colleagues (e.g. Ferguson et al., 2023; Nägel et al., 2023). This tendency appears to persist beyond teacher training and may be reinforced by experiences of time constraints and difficulties in accessing scientific sources from outside academia (van Schaik et al., 2018) as well as by social pressures (see the section on subjective norms below). Hence, it is important to better understand the factors that shape the preference for and use of scientific sources (Nägel et al., 2023; Thomm, Sälzer, et al., 2021). In this study, we investigated behavioural aspects in the form of pre-service teachers' *preferences for scientific sources* to inform themselves and *scientific source use* in the context of lesson planning during a school internship. Source preferences are classified as a behavioural aspect here because they refer to specific situations of action involving the choices of sources for obtaining information to make or justify an educational decision (Thomm, Seifried, & Bauer, 2021). These characteristics differentiate source preferences from attitudes (see below), which represent a global 'evaluation of the object' (Hogg & Vaughn, 2021, p. 157) that needs to be generalisable (Himmelfarb & Eagly, 1974).

Research use intention predicts scientific source preference and use

In the TPB model, intentions are an immediate antecedent of behaviour (Ajzen, 1991, 2020). Hence, in the context of this study, intentions to use scientific sources should predict preferences for scientific over alternative sources as well as the use of the former in addressing school-related problems. Though many studies based on the TPB have corroborated the effect of intentions on behaviour, its validity in the context of educational research use seems inconclusive. Greisel et al. (2023) found that pre-service teachers' intentions to engage in evidence-informed reasoning predicted their self-reported engagement in evidence-informed reasoning for school-related problems but not their objective behaviour (measured by an essay task). In the present study, we tested the hypothesised effect of intention to use research on pre-service teachers' preference for scientific sources and on actual research use in planning a specific lesson. Moreover, because preference for a specific type of source can be considered an intermediate step between intention and use, we also tested whether there was a direct effect of source preference on use (see Figure 1).

Attitude: Positive attitude towards research use predicts intention

In the TPB model, attitudes towards the behaviour in question play an important role since its positive or negative appraisal can strengthen or weaken one's intention to exhibit said behaviour. The literature clearly documents the crucial impact of (pre-service) teachers' attitudes towards educational research and its findings when it comes to research use (e.g. Thomm, Sälzer, et al., 2021; van Schaik et al., 2018). Favourable attitudes towards the relevance and usefulness of research have been found to be drivers of such use as a way to inform practice and decisions (Ferguson et al., 2023; Peiser et al., 2022). In contrast, critical stances, which can emerge as early as during teacher training, act as barriers that lower engagement with research. Pre-service teachers often judge educational research as irrelevant because they deem it too detached from daily classroom practice (e.g. Voss, 2022); they struggle with the nature of scientific knowledge and are unsure about its implications and applicability (e.g. Ferguson et al., 2023). These critical stances can negatively influence their intentions to draw on scientific sources. Nägel et al. (2023) showed that higher scepticism towards educational research was linked to a decreased preference for scientific sources. Along the same lines, Kiemer and Kollar (2021) found that utility beliefs about educational research positively predicted the selection and use of scientific sources. The present study adds to this research by testing the effect of relevant attitudes on intentions to use research and, in turn, on source preferences and use based on the TPB framework.

Subjective norm: Mentor's perceived research use predicts intention

Beyond individual dispositions, the preference for and use of scientific sources depend on the social context and a supportive organisational climate (Brown & Zhang, 2016; van Schaik et al., 2018). The TPB incorporates the influence of perceived social norms as *injunctive subjective norms* and *descriptive subjective norms*. The former represent the beliefs that relevant others desire, expect or even reward target behaviours; the latter arise from the perception that representatives of reference groups show the behaviours in question (Ajzen, 2020). Perceived social pressure, elicited through the descriptive norm, is particularly high when persons with considerable knowledge and skills perform the target behaviour, thus serving as role models (Fishbein & Ajzen, 2010). For pre-service teachers, in-service teachers constitute the most relevant reference group as they are seen as experts and potential role models in their future occupational field (Bullough & Draper, 2004; Hobson et al., 2009; Wang & Odell, 2002). Specifically, when pre-service teachers take their first steps during internships, mentor teachers have a stronger impact on their socialisation than university faculty (Clarke et al., 2014). Moreover, studies of teacher socialisation have confirmed that beginning teachers strongly tend to adapt their beliefs and attitudes to the social norms they perceive in schools (Zeichner & Gore, 1990).

Hence, pre-service teachers' experiences of subjective descriptive and injunctive norms during an internship will likely affect their intentions to use research. First, pre-service teachers may see that more experienced teachers rarely draw on scientific findings for everyday school life (Hobson et al., 2009; van Schaik et al., 2018; *descriptive norm*). Second, some studies have found that students are unlikely to experience the use of scientific sources as desirable or expected (*injunctive norm*) because mentor teachers usually pass on unquestioned routines instead of valuing scientific concepts and theories or linking them to school practice (Hascher et al., 2004; Hobson et al., 2009). For example, Orland-Barak and Wang (2021) showed that some mentor teachers tended to devalue the theoretical content of university-based teacher education and favour an apprenticeship-only model. These effects may explain evidence of a decrease in beginning teachers' use of scientific sources and a simultaneous increase in observational learning by experienced teachers (Allen, 2009). Hence, an important aspect of the present study was the investigation of the hypothesised effect of the social norm provided by internship mentors on research use intentions.

Perceived behavioural control: Self-efficacy for research use predicts research use intention, source preferences and use

Even if a person and their relevant others appreciate a specific behaviour, a lack of abilities or external factors (e.g. time constraints) might keep the person from performing the behaviour. Therefore, in the TPB, control beliefs—that is, the views that concern whether one has facilitating or inhibiting factors under control and whether one is 'capable of performing a given behaviour' (Ajzen, 2020, p. 317)—are considered both direct predictors of behaviour and indirect predictors via intention. Control beliefs are frequently assessed by using ratings of self-efficacy, a construct with which they overlap conceptually (Ajzen, 1991). In the context of the present study, engagement with educational research and its sources is assumed to occur with more probability if teachers feel capable of such engagement (Thomm, Sälzer, et al., 2021). For example, (pre-service) teachers need to be confident that they are able to search for, find and understand research in order to consider engaging with it. Literature on information literacy and online information seeking has suggested relationships between finding, selecting and evaluating (online) information and self-efficacy beliefs (Andreassen & Bråten, 2013; Flemming et al., 2015). To follow up on this body of research, the present study tested the direct and indirect effects of self-efficacy implied by the TPB.

The present study

As discussed above, the TPB provides a powerful framework to analyse the factors driving teachers' research use. In the present study, we applied the TPB to model pre-service teachers' source preferences and subsequent use in lesson planning—a typical task for pre-service teachers during school internships. We tested the following sets of hypotheses, which are implied by the TPB model (Figure 1).

Set H1—predictors of intention: (a) positive attitude, (b) subjective norm and (c) self-efficacy are positive direct predictors of the intention to use educational research.

Set H2—predictors of source preferences: (a) intention and (b) self-efficacy are direct predictors of source preferences; (c) positive attitude and (d) subjective norm (i.e. the perceived research use of mentors) are indirect predictors of scientific source preferences via intention.

Set H3—predictors of source use: (a) scientific source preferences, (b) intention and (c) self-efficacy are direct predictors of scientific source use; (d) intention and (e) self-efficacy are indirect predictors of scientific source use via source preferences.¹

Though this study did not focus on this aspect, we expected positive correlations among the exogenous model variables (i.e. positive attitude, subjective norm and self-efficacy; see Ajzen, 2020).

METHODS

Design and participants

The study's participants were $N = 343$ pre-service teachers currently doing a half-year school internship at the end of their master's degree at University of Erfurt. We recruited the participants in a university course linked to the internship. The majority (87.2%) of participants were enrolled in a primary teacher education programme, while 12.2% aimed to become secondary school teachers (0.6% other/missing). In line with the typical overrepresentation of women in primary teacher education, 82.5% of the participants were female. Data were collected via an online survey.

Participation in the study was voluntary, and the participants' informed consent was obtained. Because the study posed no foreseeable risk of harm or discomfort for the participants, no formal approval from a governing or institutional review board was required. We followed the ethical guidelines of the American Psychological Association as well as the *Code of Ethics* of the World Medical Association (the *Declaration of Helsinki*) for research with humans.

The data, codebook and analysis files are available on the Open Science Framework (OSF) at <https://osf.io/hejxa/>.

Instruments

Below, we describe the administered measures. Descriptive statistics, including reliability estimates, can be obtained from Table 1 in the Results section.

Attitudes towards research use

We adopted 18 items on four subscale from Haberfellner (2016) and Thomm, Sälzer, et al. (2021). These items addressed to what extent the participants considered research useful in the context of school and teaching (a) in general, (b) for informing actions and decisions, (c) for justifying actions and

¹We chose not to test the longer indirect effect chains of attitude and social norm on source use via intention and preference (see Figure 2) because these effects could be expected to be quite low due to the multiplication of the respective direct effects.

TABLE 1 Means (*M*), standard deviations (*SD*), reliabilities (Cronbach's alpha values) and latent correlations.

| | <i>M</i> (<i>SD</i>) | α | (1) | (2) | (3) | (4) | (5) |
|--|------------------------|----------|--------|--------|--------|--------|-----|
| (1) Positive attitudes towards research use | 4.54 (0.71) | .83 | – | | | | |
| (2) Subjective norm (perceived research use of mentors) | 2.95 (0.84) | .67 | .28*** | – | | | |
| (3) Behavioural control (self-efficacy for research use) | 4.54 (0.79) | .88 | .63*** | .27*** | – | | |
| (4) Research use intention | 4.46 (0.90) | .86 | .80*** | .44*** | .67*** | – | |
| (5) Scientific source preference | 4.61 (0.89) | .75 | .77*** | .24*** | .63*** | .71*** | – |
| (6) Scientific source use | 0.45 (0.57) | – | .10 | .27*** | .14 | .20** | .13 |

** $p \leq .01$, *** $p \leq .001$.

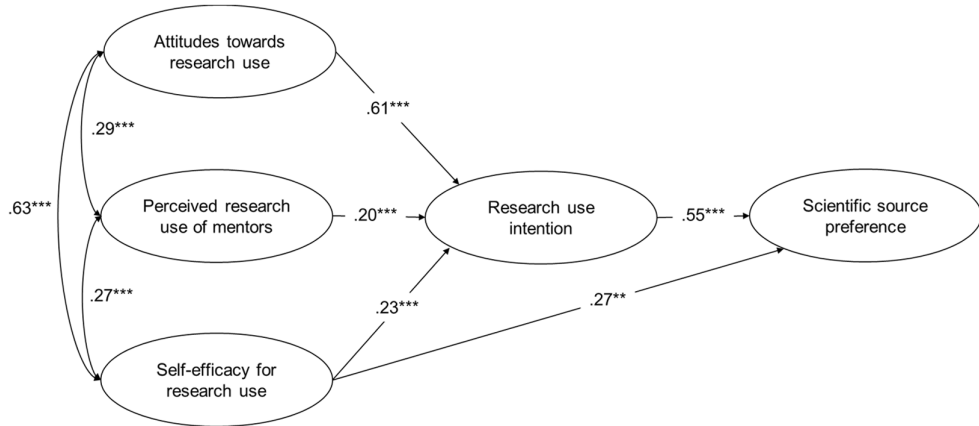


FIGURE 2 TPB model of pre-service teachers' intended research use and scientific source preference. Standardised regression estimates from Model 1; ** $p \leq .01$, *** $p \leq .001$; measurement part of the model omitted.

decisions and (d) for analysing and understanding teaching practice (example item: 'Research results are useful to justify my teaching practice with scientific evidence'; for the complete list of items, see the Data availability statement below).

Subjective norm (perceived research use of mentors)

We constructed eight items on the participants' perceptions of their mentors' research use. These items built two subscales that addressed descriptive (measured by the source use mentor teachers employed to plan their lessons and deal with problems in everyday school life) and injunctive subjective norms (example item: 'My mentor at school expected me to take educational research findings into account when planning my teaching').

Behavioural control (self-efficacy for research use)

Self-efficacy was measured by six items adopted from Williams and Coles (2007) (example item: 'I am confident that I can find scientific information relevant to my teaching').

Research use intention

Four items measured the intention to use research as a teacher (example item: 'As a teacher, I intend to inform myself about new educational research findings').

Scientific source preference

Three items adopted from Futterleib et al. (2022) asked participants to rate their preferences for using scientific sources in order to justify their positions about teaching-related topics (example item: 'Evidence on aspects of the topic from scholarly journal articles'). These items were mixed with six additional items representing non-scientific sources that served as distractors. The participants viewed the items at random. Only the scientific source items were analysed in this study.

Scientific source use

Three similar items were employed to measure the use of sources in the internship. For this purpose, pre-service teachers planned, prepared and taught a lesson for which they indicated which sources they had used ('What sources did you use to prepare your lesson?'). As one item had a low item-test correlation (scientific textbooks), we only used two items that queried scientific sources (scholarly journal articles and further scientific literature) and built a sum score.

With the exception of source use, the answer format for all the items was a 6-point rating scale in which the higher values indicated higher prevalence. As the items on research use intention and subjective norms were self-developed, we conducted cognitive pretests with student teachers as part of the development process. The items for the constructs, including the subscales (i.e. attitude and subjective norm), were aggregated per subscale prior to the analysis; these composite scores served as indicators to reduce complexity in the structural equation model (Little et al., 2002). A preparatory confirmatory factor analysis (CFA), which included the five investigated constructs and the manifest sum score for source use as correlated factors, exhibited good model fit, as judged by standard fit indices, $\chi^2(156) = 301.630, p < .001, CFI = .950, RMSEA = .052$ [90% CI .043, .061], SRMR = .046. All the measures proved to be sufficiently reliable (Table 1).

Analyses

We employed structural equation modelling (SEM) with robust full information maximum likelihood (FIML) estimation in Mplus 8.9 (Muthén & Muthén, 1998). First, the hypotheses in sets 1 and 2 were tested (Model 1); then, those in set 3 were tested by including source use as an additional dependent variable (Model 2). Indirect effects were tested for significance with the Sobel test.² We used a confirmatory approach to model testing with no post-hoc model modifications.

RESULTS

Descriptive results

The descriptive statistics are summarized in Table 1. Overall, the participants reported favourable views regarding the use of educational research, with answers on average located in the upper half of the scale. However, they perceived the subjective norms provided by their mentors as somewhat below the midpoint of the scale.

Table 1 also contains the latent correlations among the investigated constructs obtained from the preparatory CFA (see the section on the Instruments above). The results showed substantially large

²The Sobel test may deliver inaccurate results if it is not conducted on very large samples. Hence, we ran again the analyses using bias-corrected bootstrap confidence intervals to test for indirect effects (MacKinnon, 2008). This required using the normal-theory maximum likelihood estimator because the bootstrap method is unavailable with MLR. The findings of both analyses proved to be numerically almost identical, and the bootstrapped results confirmed the Sobel tests. The complete output of the bootstrapped analysis is available on the OSF.

bivariate relationships between the exogenous TPB model variables (i.e. attitude, subjective norm and behavioural control) and research use intention and scientific source preferences.³ All the correlations were in the expected directions. Only the correlation between subjective norm and scientific source preference was comparatively smaller, but it was still statistically significant. Scientific source use, which pertained to the lesson taught for the internship, showed small-to-medium significant correlations with intention and subjective norm; the correlations with attitudes, self-efficacy and scientific source preference showed the expected direction, but they were small and not statistically significant. Concerning the exogenous variables, a positive attitude towards research use was strongly correlated with self-efficacy and, to a lesser degree, subjective norm. Subjective norm and self-efficacy exhibited a moderately significant correlation.

TPB model of scientific source preference and use

The fit of both Model 1, which predicted scientific source preference, and Model 2, which added source use as a dependent variable, was good, M1: $\chi^2(144) = 346.727$, $p < .001$, CFI = .943, RMSEA = .058, 90% CI [.049, .067], SRMR = .051; M2: $\chi^2(160) = 332.486$, $p < .001$, CFI = .941, RMSEA = .056, 90% CI [.048, .065], SRMR = .052.

All the effects of set H1 and set H2 were statistically significant and went in the direction predicted by the TPB. Regarding set H1, the effects on intended research use were large for positive attitude and approximately medium for subjective norm and self-efficacy. Concerning set H2, there was a large effect of intention and a medium one of self-efficacy on scientific source preference. As predicted, the Sobel tests showed that positive attitude ($\beta = .34$, $p < .001$), subjective norm ($\beta = .11$, $p = .001$) and self-efficacy ($\beta = .13$, $p = .004$) had statistically significant indirect effects on scientific source preference via intention. The standardised parameter estimates for the structural model part are displayed in [Figure 2](#).⁴

In contrast, the results of Model 2 (see [Figure 3](#)) contradicted set H3. None of the direct predictors of scientific source use reached statistical significance, with only intention descriptively having a small-to-medium positive effect (ns). Because the effect of source preference on source use was essentially zero, so were the indirect effects of intention ($\beta = -.03$, $p = .657$) and self-efficacy ($\beta = -.02$, $p = .658$).

DISCUSSION

Drawing on scientific sources is a precondition for engagement in evidence-informed practice. In this study, we sought to identify predictors of pre-service teachers' preference and use of scientific sources based on the TPB (Ajzen, 1991, 2020). To this end, we surveyed pre-service teachers doing a long-term internship with regard to their attitudes, self-efficacy beliefs, subjective norms linked to mentor teachers and research use intentions. We recorded two variables as target behaviours: (1) to what extent pre-service teachers preferred scientific sources for justifying decisions and (2) whether they used scientific sources to plan a lesson they had to teach during the internship. Based on the TPB, we expected that preferences would predict the actual use of scientific sources.

³Due to the large correlations among attitude, intention and source preference, it is worthwhile to investigate whether these variables measured distinct constructs. To investigate this, we ran CFA model comparisons. For each pair of variables, we tested a one-factor model where all the items loaded on a single general factor against a two-factor model where each item loaded on its respective factor. The results are available in [Table S1](#) of the online supplement, and the analysis and output files can be accessed on the OSF. In each instance, the two-factor model demonstrated significantly better fit to the data than the respective one-factor model, and all the one-factor models exhibited poor absolute fit. This indicates that, in addition to theoretical differences, the constructs can also be empirically differentiated.

⁴The measurement part of the model is omitted from the figure to avoid clutter. The factor loadings ranged between .57 and .89; for the full results, see the output files on the OSF.

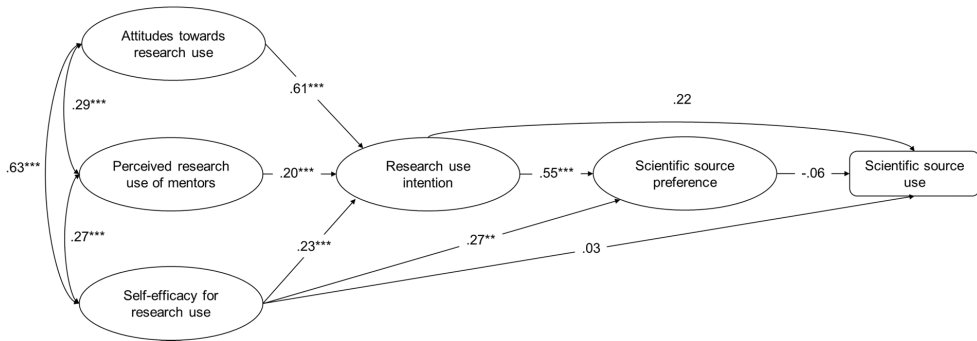


FIGURE 3 TPB model of pre-service teachers' intended research use, scientific source preference and scientific source use. Standardised regression estimates from Model 2; ** $p \leq .01$, *** $p \leq .001$; measurement part of the model omitted.

Summary and interpretation of findings

The SEM results showed that the TPB successfully explained scientific source preferences as an important aspect of pre-service teachers' behaviours concerning evidence-informed practice. As hypothesised, attitudes towards and self-efficacy for research use as well as subjective norm linked to mentor teachers directly predicted pre-service teachers' intentions to use research (H1); they also indirectly predicted preferences for scientific sources via intentions (H2). *Attitudes* towards research use had the highest predictive power for research use intentions and scientific source preferences via intentions. These findings add to prior findings which indicate that positive attitudes towards the usefulness and applicability of research in one's practice are preconditions for actual use (van Schaik et al., 2018). In our study, on average, pre-service teachers felt that research would help them to understand teaching practices as well as inform and justify actions and decisions. *Self-efficacy* for research also directly predicted intentions and preferences for scientific sources, albeit with lower regression weights than attitudes. This finding echoes existing studies that have found that teachers need to feel capable of finding scientific sources, understanding them and applying them to the issue at hand (Thomm, Sälzer, et al., 2021; van Schaik et al., 2018). One implication for teacher education is to look closer at promoting positive attitudes and self-efficacy beliefs about educational research use, alongside relevant skills. While there are already trainings that address research knowledge and sourcing skills (e.g. Böttcher-Oschmann et al., 2021; Engelmann et al., 2022), future interventions should also consider motivational outcomes (Bock et al., 2023).

Of particular interest to this study was the hypothesis that the *social norm* provided by mentors during internships would affect pre-service teachers' intentions to use research as well as their subsequent preferences for scientific sources. The interest in this social influence was driven by evidence that pre-service teachers tend to consider in-service teachers as a more reliable and valid information source than teacher education courses and faculty (Bråten & Ferguson, 2015; Peiser et al., 2022). Our findings corroborated the direct effect of subjective norm on intention and its indirect one on scientific source preference. In terms of size, this effect was similar to the one of self-efficacy, but it was substantially smaller than the effect of attitude. Indeed, subjective norm has often been found to have rather small effects on behavioural intentions (e.g. Armitage & Conner, 2001). Still, one might have expected a larger effect in this study given the frequently suggested influence of practical school experiences on pre-service teachers' stances towards educational research.

Regarding the third hypothesis, in contrast to our assumption, the actual use of scientific sources for lesson preparation was not shaped by pre-service teachers' self-efficacy, intentions to use research or source preferences. One explanation for this finding might be the different contextualisation of our questions on preference and use regarding scientific sources (see Hendriks et al., 2021). While the source preference questions referred to using information for justifying school-related decisions, the source use questions related to the planning of a specific lesson. It is possible that these contexts were too different

to find a relationship between preference and actual use. This could also explain the non-significant, small-to-medium positive effect of intention on source use as well as the significant bivariate correlation between the two, as intention was also measured with respect to the use of research for lesson planning in two of the four items. Interestingly, we found a significant bivariate correlation between subjective norm and source use. Perhaps, subjective norm works also on pathways not considered by the TPB model. For example, MacFarlane and Woolfson (2013) found that subjective norm was the only significant predictor of actual inclusive teaching behaviour in their study, even though it was unrelated to behavioural intentions, which indicates a direct rather than an indirect effect on behaviour. We tested this possibility in an exploratory post-hoc analysis by adding a direct path from subjective norm to scientific source use in M2; the result was statistically significant, $\beta = .23, p = .013$.⁵ One explanation might be that pre-service teachers received support from mentor teachers in planning their teaching, which led to a direct effect on source use and no connection to source preference. However, these putative mechanisms cannot be further clarified with the present data. Hence, it might be worthwhile to test these alternative pathways in future studies.

Limitations

Though the results of this study were mostly in line with its theoretical predictions, several limitations are worth noting. First and foremost, the non-experimental study design does not allow us to draw causal conclusions. Any causal interpretations made here are based solely on theoretical reasoning linked to the TPB. In particular, this concerns the examined indirect effects, as the testing of mediation models with cross-sectional data is problematic (e.g. MacKinnon, 2008). For example, equivalent models exist that involve different causal structures but are statistically indistinguishable from the models presented in this paper (Hershberger, 2013). While fully acknowledging these limitations, we are of the opinion that the TPB provides a reasonably well-established framework with a solid body of supporting evidence (e.g. Armitage & Conner, 2001); hence, the assumptions about causal relations implied by our model are probably not completely misconceived. Moreover, it is essential to emphasise that the purpose of this study was not to test the TPB's causal model but to investigate whether it can successfully be applied to the special case of predicting pre-service teachers' intentions to use research as well as their preferences for and use of scientific sources. By doing so, we employed a tried and tested theory to gain a better understanding of the problem at hand. This approach has been deemed important in the literature—see, for example, Rousseau and Gunia's (2016) review of evidence-based practice—and has been identified as a research gap (Greisel et al., 2023; Nägel et al., 2023). Still, we encourage further experimental studies to deepen our understanding of the causal factors that shape (pre-service) teachers' research use. For instance, the subjective norm could be manipulated by presenting scenarios or by situating students in task settings where significant others, such as mentors and colleagues, convey varying expectations concerning the reception and use of scientific sources.

The second limitation is that we measured the use of scientific sources for preparing a lesson for the internship with self-reports. While we fully acknowledge the benefits of directly measuring behaviour, doing so would have closely resembled our self-reported approach (e.g. students could have submitted the sources of information used for the lesson instead of stating them). Furthermore, our measurement aligns with Ajzen's (2020) recommendation to assess behaviour as closely in time as possible and not hypothetically. In our study, the reference to a planned lesson provided such a timely and situation-specific anchor. Nevertheless, one possibility to assess behaviour more directly could involve having participants engage in thinking aloud during lesson planning or requesting them to provide explanations immediately afterwards. This approach would enable the analysis of the respective protocols for traces

⁵The full model results are available on the OSF.

of scientific evidence. Also, with regard to data collection, all of our measures were questionnaire based. This might have led to problems such as common method bias, response styles and social desirability bias (i.e. participants might have wanted to evoke the impression of being research oriented in a survey conducted by a university). Potentially, these biases could have artificially inflated the variable relationships examined in this study. This possibility notwithstanding, students are often quite frank about their disregard for educational research, both in empirical studies (Peiser et al., 2022; Voss, 2022) and in personal interactions with teacher education faculty. Still, future studies could collect data on source use that is less prone to the above-mentioned biases, such as analysing behavioural traces.

Third, sceptical readers might question why a theoretical framework as well established as the TPB should *not* transfer to the specific context addressed in this study. Similarly, some might even raise concerns about the falsifiability of the TPB. We argue that the TPB clearly entails hypotheses that, in principle, can be rejected by empirical data. Hence, the fact that the theory is well substantiated does not invalidate its potential falsifiability. Furthermore, even a plausible and well-supported theory can still prove to be incorrect or fail to generalise when applied to new areas. Therefore, studies that use it are neither redundant nor trivial. Berliner (2002) succinctly explained that theories and findings often fail to generalise across contexts in educational psychology. Indeed, several recent studies have only found partial confirmation for the TPB in educational contexts (Greisel et al., 2023; Knauder & Koschmieder, 2019; MacFarlane & Woolfson, 2013). Overall, we regard the application of a well-established framework as a strength rather than a limitation of this study.

CONCLUSION

Despite the above limitations, we believe that the present study advances prior research by highlighting the impact of both individual and social-contextual factors on pre-service teachers' intentions to use educational research and related source preferences. Compared to existing studies, a further strength of this work is the consideration of the use of scientific sources specifically in relation to a lesson pre-service teachers had to plan during their internship, which provided a specific and timely anchor for them to indicate their behaviours (see Ajzen, 2020). Because pre-service teachers commonly face stark barriers when accessing scientific sources after leaving university (Thomm, Sälzer, et al., 2021), it is important to improve our understanding of the conditions under which they are ready to consult educational research and turn to relevant sources. This knowledge will enable us to develop precise interventions to equip pre-service teachers with the relevant skills and mindsets needed to engage with educational research. Admittedly, fostering favourable attitudes towards research use and perceptions of self-efficacy in handling the search for and use of scientific literature may not fully solve teachers' daily challenges, because external influences such as lack of access to scientific knowledge or time constraints can severely inhibit research usage (Thomm, Sälzer, et al., 2021; cf. Rousseau & Gunia, 2016). Still, doing so may make it easier to use research when the efforts invested are also seen as being well spent. Two promising approaches to teacher education are inquiry-based learning (Böttcher-Oschmann et al., 2021; van Katwijk et al., 2019) and utility-value interventions (Hulleman & Harackiewicz, 2021). The latter emphasises the utility of educational research for school practice, including the use of writing prompts, reflection tasks or authentic examples/classroom videos to analyse problems with the help of empirical results or educational theories (Renkl, 2022). However, these interventions may be of modest use when pre-service teachers observe early on that they are not expected to use scientific sources after university. Therefore, our results underline the relevance of incorporating internship mentor teachers as role models. A way forward may be collaborations between researchers, mentors and pre-service teachers aimed at engaging with inquiry-based reflection or action research (Ferguson, 2021). Although empirical evidence on the effects of this kind of collaborative teacher research is still mixed (Willegems et al., 2017), building a *third space* (Zeichner, 2010) may help to reduce the perceived barriers between theory- and practice-based teacher education.

AUTHOR CONTRIBUTIONS

Bernadette Gold: Conceptualization; methodology; data curation; supervision; formal analysis; investigation; funding acquisition; project administration; resources; writing – review and editing; writing – original draft; visualization. **Eva Thomm:** Investigation; writing – original draft; writing – review and editing; visualization; resources; funding acquisition. **Johannes Bauer:** Funding acquisition; writing – original draft; writing – review and editing; validation; visualization; methodology; formal analysis; resources.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Open data and materials are available on the open science framework: <https://osf.io/hejxa>.

ETHICS STATEMENT

The authors declare that the work described has been carried out in accordance with The Code of Ethics of the American Psychological Association and the World Medical Association (Declaration of Helsinki) for research involving humans. No formal approval from an ethics board was required at the time of the data collection because the study was negligible risk research.

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