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SPECIALTY SECTION
This article was submitted to
Teacher Education,
a section of the journal
Frontiers in Education

RECEIVED 21 June 2022
ACCEPTED 05 October 2022
PUBLISHED 26 October 2022

CITATION
Ferguson LE and Bråten I (2022)
Unpacking pre-service teachers'
beliefs and reasoning about student
ability, sources of teaching
knowledge, and teacher-efficacy:
A scenario-based approach.
Front. Educ. 7:975105.
doi: 10.3389/educ.2022.975105

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Unpacking pre-service teachers' beliefs and reasoning about student ability, sources of teaching knowledge, and teacher-efficacy: A scenario-based approach

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The beliefs teachers hold may provide information about their more or less evidence-informed reasoning about educational issues. However, gaining a clear picture of teachers' beliefs has proven difficult. A promising line of inquiry uses scenario-based approaches to assess teachers' enacted beliefs. Accordingly, we assessed 75 Norwegian pre-service teachers' beliefs about student ability, sources of teaching knowledge, and teacher efficacy by analyzing their written responses to authentic classroom scenarios, with these responses also providing information about participants' reasoning about the scenarios. While participants' responses seemed to be evidence-informed in many ways, there were also indications of the opposite, such as limited consideration of educational research in pedagogical decision-making. The results contribute uniquely to an understanding of pre-service teachers' beliefs and reasoning about educational issues. As such, they may help researchers and teacher educators to better understand the beliefs pre-service teachers hold, as well as to facilitate further development of these beliefs. Implications for future research and teacher education are discussed.

KEYWORDS

teacher beliefs, teacher education, pre-service teachers, scenario-based assessment, evidence-informed reasoning

Introduction

On which information pre- and in-service teachers base their decisions and actions is an important question for teacher education, as well as for the society at large. Exemplary teacher education programs are theoretically-rather than craft-oriented and grounded in the complexities of modern teaching (Kitchen and Petrarca, 2016). At the

same time, pre-service teachers in the information society have more access to scientific, research-based knowledge than their predecessors. Still, empirical studies have clearly documented pre- as well as in-service teachers' preference for informal or experience-based over research- or evidence-informed sources of teaching knowledge (Thomm et al., 2021c; Ferguson et al., 2022). Possible reasons for this dilemma include lacking competency or efficacy in using and reasoning about research-based knowledge, or even unwillingness to do so (Thomm et al., 2021b). Teacher educators meet students who have vast experiences as students in classrooms. Based on those experiences, pre-service teachers in initial teacher education programs may hold well-developed, potentially powerful belief systems about education that are incompatible with established bodies of knowledge from relevant fields, such as the educational and learning sciences (Menz et al., 2021). Further, these beliefs are likely to influence their interactions with educational theories and research (Ferguson et al., 2022).

Reproduction of teaching practices primarily grounded in own experiences may be undesirable, detrimental even, for student learning and development (Csandi et al., 2021), as well as being inconsistent with current national and international policies that recommend evidence-informed practice where reasonable (European Commission, 2007). Thus, there have been several investigations into teachers' evidence-informed reasoning (or the lack of it) about educational problems (Csandi et al., 2021; Zimmermann and Mayweg-Paus, 2021), with evidence-informed reasoning referring to taking relevant theory and research into consideration when making decisions and taking action to solve educational problems (Ferguson, 2021). In this study, we wanted to explore this problem space from a teacher beliefs perspective. Inspired by a broad framework of teacher beliefs (Fives and Buehl, 2008; Fives et al., 2019) and state-of-the-art methods for investigating beliefs (Bullough, 2015; Sabatini et al., 2018; Lunn Brownlee et al., 2021), we designed and tested an innovative scenario-based problem-solving approach in addressing how pre-service teachers enacted their beliefs about student ability, sources of teaching knowledge, and teacher efficacy, also looking for signs of evidence-informed reasoning in their written responses to those scenarios. Of note is that our focus on these three types of beliefs (i.e., beliefs about student ability, sources of teaching knowledge, and teacher efficacy) was based on the empirically grounded framework of teacher beliefs discussed by Fives and Buehl (2008, 2016), Fives et al. (2019). As parts of a belief system (Fives and Buehl, 2008), such beliefs may be more or less congruent, with beliefs in the malleability of student ability, formalized sources of teaching knowledge (i.e., educational theory and research), and their own ability to support learning for all students potentially indicating a congruent system of teacher beliefs. This study did not aim to investigate relations between beliefs about student ability, sources of teaching knowledge, and teacher efficacy,

however. And, while we also did not aim to investigate relations between such teacher beliefs and evidence-informed reasoning, the scenario-based approach to studying beliefs about educational issues that we used may act as a window to exploring both beliefs and evidence-informed reasoning. In what follows, we present a conceptualization of teacher beliefs and relevant work on beliefs about student ability, sources of teaching knowledge, and teacher-efficacy. Before we present our scenario-based study and discuss the implications of our findings for teacher educators and educational researchers, we briefly discuss a scenario-based approach to studying teacher beliefs.

Teacher beliefs

Teacher beliefs are individual interpretations and experience-based propositions held by teachers that influence their teaching (Fives et al., 2019; Ferguson and Lunn Brownlee, 2021). Given teachers' long apprenticeship of observation (Lortie, 1975) and, not least, participation in educational settings, their beliefs are likely to be rather deeply entrenched, and may act as a barrier to acquisition of new knowledge in the form of theories and research in teacher education (Guilfoyle et al., 2020; Menz et al., 2021). Following Fives and Buehl (2008), we view teacher beliefs as parts of a belief system that gives meaning to their interactions, intentions, and actions (Buehl and Beck, 2015; Buehl and Fives, 2016; Dweck and Molden, 2017). Broadly speaking, teacher belief researchers have focused on how pre-service teachers and teachers frame and comprehend their experiences, for example, how they interpret students' behavior and academic performance, plan and adapt their teaching, and perceive themselves as teachers. Presumably, such beliefs will also influence the sources of teaching knowledge they choose to engage with, whether in terms of educational research literature or respected practice teachers and colleagues (Tschannen-Moran and Hoy, 2001; Fives and Buehl, 2008). Some beliefs that teachers hold can be termed misconceptions or misinformation beliefs because they indicate reliance on incorrect information or lack of evidence, whereas other teacher beliefs can be termed accurate because they indicate reliance on correct information or evidence (Ecker et al., 2022).

Teachers' beliefs about student ability

A well-known example of the potential role of teachers' beliefs about student ability is the original Pygmalion effect study by Rosenthal and Jacobsen (1968). In that study, teachers were led to believe that a proportion of the young students in their classrooms were so-called "late-bloomers," as identified by a fictitious diagnostic test, and could therefore be expected to experience higher cognitive growth and resulting gains in IQ scores in the future, a prediction that was confirmed

and upheld in follow-up studies. The results of this well-known, yet oft miscited study, have been used to highlight the importance of teachers' views of their students and the students' chances of future success (Jussim and Harber, 2005). Proposed explanations for the actual, resulting differences in performance by alleged late-bloomers and the control group included differences in amounts and types of feedback, emotional support, and availability in terms of time spent with the different students, as well as the provision of suitably challenging opportunities for growth for those who were identified as "late-bloomers" (Jussim, 1986).

Such effects also have resonance in the work of Dweck et al. (e.g., Dweck and Leggett, 1988; Dweck, 2000; Yeager and Dweck, 2012; Dweck and Molden, 2017). In essence, Dweck's meaning system theory holds that beliefs about the malleability or stability of human attributes, such as ability or intelligence, give meaning to situations in which those attributes are involved. More specifically, viewing ability as malleable is considered more adaptive in learning and achievement settings because it can lead to mastery goals, strategic effort, and persistence and ingenuity in the face of challenge or setback (Dweck, 2000; Dweck and Molden, 2017). For teachers, their views of students' ability are also likely to influence their perceptions and behaviors in terms of the goals and ambitions they hold for the students and how they interpret student behavior in the classroom (Hattie, 2012). That is, teachers viewing student ability as malleable may be more likely support learning for all students and attribute students' successes and failures to their own teaching, among other factors, rather than to stable attributes of the students. On the other hand, teachers viewing student ability as stable, may be more likely to attribute different levels of academic performance to different levels of "smartness," and thus harbor higher ambitions for the smarter students. Accordingly, empirical studies focusing on teachers' beliefs about student performance (Jonsson et al., 2012; Patterson et al., 2016) have suggested that teachers who attribute student performance to underlying, stable ability are more likely to hold stereotypical views of students (Jonsson and Beach, 2012), for example, as "smart," "bright," "lazy," or "ungifted," which, in turn, influence the teaching practices these teachers tend to engage with their students (Patterson et al., 2016).

Patterson et al. (2016), who examined 53 American pre- and in-service teachers' beliefs about factors influencing student academic performance using a quantitative, survey-based approach, identified distinct factors related to the school (e.g., the school culture), the family (e.g., parents' income and education), and the students themselves (e.g., their intelligence). These authors argued that the relative weight of teachers' beliefs about the importance of the different factors would contribute to differences in their approaches to students, for example, in terms of teacher effort, instructional methods, and interactions.

Teacher beliefs about sources of teaching knowledge

Beliefs about sources of knowledge and, in turn, how individuals select, evaluate, and use such sources are essential epistemic questions with particular relevance to teacher beliefs and reasoning, given the perennial debates on the nature of teaching knowledge and valid sources of teaching knowledge (Shulman, 1987; Buehl and Fives, 2009; Thomm et al., 2021c). Teachers' beliefs about sources of teaching knowledge may be considered a domain-specific form of source of knowledge beliefs (Buehl and Alexander, 2001; Guilfoyle et al., 2020), which will likely influence the information teachers chose to engage with and use.

While beliefs about sources of knowledge traditionally have been conceptualized as falling on a continuum from reliance on external authority to personal construction of knowledge (Schommer, 1990; Hofer and Pintrich, 1997), more recent conceptualizations have highlighted the importance of testimony from external sources in advanced, scientific reasoning (Chinn et al., 2011). In terms of teaching, valuable testimony may come from both collegial and scientific sources. Thus, teachers may come to rely on a mix of craft, experience-based and theoretical, research-based knowledge sources, which makes their resulting teaching knowledge somewhat personalized in the sense that it is influenced by teachers' life experiences in addition to recognized bodies of knowledge from different fields (Shulman, 1987; European Commission, 2007).

Buehl and Fives (2009) used a mixed-methods approach to study beliefs about sources of teaching knowledge among 110 pre- and in-service teachers who responded to open-ended questions such as "where does knowledge of how to teach come from?" The authors identified the following six main themes related to sources of teaching knowledge in participants' responses: formal education in terms of pre-service education and professional development; formalized bodies of knowledge, including research articles and the Internet; observational (or vicarious) learning from other teachers; collaboration and shared meaning making; enactive experiences from personal, professional, and other experiences; and self-reflection and synthesis of information and experiences. In accordance with this study, pre-service teachers' and teachers' emphasis on personal, enactive, and experienced-based knowledge has been confirmed in later work (e.g., Bråten and Ferguson, 2015; Kiemer and Kollar, 2021; Thomm et al., 2021c; Ferguson et al., 2022). Still, the mechanisms explaining this emphasis have only recently become the object of more systematic investigation. For example, Hendriks et al. (2021) found an interaction between pre-service teachers' epistemic aims (gaining insights into educational research vs. receiving practically applicable knowledge), which were experimentally manipulated, and how they judged the expertise of researchers vs. teachers. Specifically, when the aim was theoretical explanations of education, the pre-service teachers ascribed more expertise to researchers than

to teachers, but when the aim was to gain more practical knowledge, they ascribed more expertise to experienced teachers than to researchers. Further, pre-service teachers who perceived educational research to be more useful were also more likely to ascribe higher expertise to researchers.

Perceived irrelevance of educational research among pre-service teachers and teachers may highlight the need for teacher educators to make their own evidence-based practice more explicit (Ferguson, 2021) and try to foster beliefs about educational research as ways of considering one's own practice in a different light (Guilfoyle et al., 2020). That existing beliefs about sources of knowledge may act as obstacles to engaging with educational evidence is also consistent with findings reported by Thomm et al. (2021a). These authors introduced the idea of motivated reasoning about educational research that contradicted pre-service teachers' existing beliefs, showing that pre-service teachers may be more critical to the usefulness of educational research in reasoning about an educational issue when the evidence is at odds with their own prior beliefs. However, Thomm et al. (2021a) also found that pre-service teachers reported positive views of scientific (i.e., educational sciences) sources.

Teacher-efficacy beliefs

Teacher-efficacy beliefs refer to the beliefs teachers hold about themselves and their ability to perform given tasks, especially supporting learning, engagement, and performance in students (Tschannen-Moran et al., 1998; Tschannen-Moran and Hoy, 2001). Originating in Bandura's (1997) construct of perceived self-efficacy, teacher-efficacy applies to teachers' beliefs about personal or collective efficacy, or a combination of the two (Tschannen-Moran et al., 1998). Further, teacher-efficacy may influence how opportunities and challenges in the teaching environment are perceived, as well as the choice of learning activities, effort, and perseverance (Skaalvik and Skaalvik, 2007), and its influence may even extend to the levels of lesson planning and organization (Tschannen-Moran and Hoy, 2001). Teacher-efficacy is a multi-dimensional and context-specific construct that is based on teachers' prior experiences and their interpretations and attributions (Skaalvik and Skaalvik, 2007). More specifically, its dimensionality includes efficacy for adapting instruction to student needs, motivating and engaging students, managing classrooms and maintaining discipline, cooperating with colleagues and parents, coping with changes and challenges, and influencing student outcomes (Tschannen-Moran and Hoy, 2001; Skaalvik and Skaalvik, 2007, 2014).

Fives and Buehl (2008) drew parallels between teacher-efficacy and lay theories of intelligence (see Section "The present study"), extending views of malleable or stable human attributes to the area of teaching. That is, teachers may hold the belief that teaching ability is a stable attribute they are born with (or not), as opposed to viewing teaching as skills and knowledge

that can be learned and further developed, with the latter view possibly being more conducive to engaging with and making use of educational research and theories. Thus, teachers who believe they can make an influence may not only be more likely to invest effort in their teaching, but also to draw on more, and varied sources of teaching knowledge in doing so. Patterson et al. (2016) further suggested that high-efficacy teachers tend to focus on the aspects of teaching situations they can control, which, in turn, may contribute to feelings of efficacy as well as satisfaction.

A scenario-based approach to measuring teacher beliefs

Gaining an understanding of pre-service teachers' beliefs and associated reasoning is important if teacher educators and researchers are to capitalize on the funds of knowledge, or correct the misconceptions or non-availing beliefs, that these fledgling teachers possess. However, measuring the "messy construct" (Pajares, 1992) of teacher beliefs is a tricky business (Tschannen-Moran and Hoy, 2001; Schraw and Olafson, 2015). Earlier studies have employed manifold approaches, with "questionnaires, verbal reports, performance observations, self-reflective writing, tests and exams, vignettes, scales, portfolios, visual representations, and instructional and classroom artifacts" dominated existing assessment strategies in the literature (Schraw and Olafson, 2015, p. 90). A major assessment issue that is particularly troublesome for teacher belief researchers is the unclear relation between reported beliefs and beliefs enacted in practice (Buehl and Beck, 2015). For example, there is some evidence that teachers' espoused beliefs are not present in their enacted practices and that teachers engage in practices they indicate that they do not support (Buehl and Beck, 2015). Further, beliefs may be enacted in different ways depending on context, but such context-specificity may be difficult to capture by quantitative methods such as questionnaires that ask teachers to think about their past or future practice in abstract and general terms (Patterson et al., 2016). Similarly, the provision of pre-conceived answers in multiple-choice measures may provide appealing alternatives that draw attention to desired or ideal responses that are not commensurate with the intricate realities of practice.

On the other hand, qualitative approaches have several advantages in trying to capture messy constructs, including the discovery (rather than testing) of variables and allowance for deeper understanding of complex constructs and relations (Olafson et al., 2015). Well-designed, transparent qualitative methods may therefore offer new insights into pre-service teachers' beliefs. One such approach, which also has been used in other areas of educational psychology research (Hartmann et al., 2021; Lunn Brownlee et al., 2021; Wang et al., 2021), is scenario-based. Basically, a scenario-based approach

presents an imagined or hypothesized event or context that establishes a credible purpose for the individual's decisions and actions. As such, it not only provides a framework for the assessment but also represents a step toward more ecological validity (Sabatini et al., 2018). In this study, we aimed to create a series of domain-specific scenarios that were instructionally relevant to the participants and covered the constructs that we targeted. These scenarios introduced hypothetical problematic events related to teaching and learning that required decisions and actions on part of the participants (see Section "Materials" for further description of the content of these scenarios).

Compared to self-reports or questionnaires, the scenario-based approach that we implemented allows for exploration of beliefs at a level closer to enactment, and it may thus be more useful in exploring the context-dependent nature of beliefs (Bullough, 2015). For example, Kiemer and Kollar (2021) recently explored a scenario-based approach to assessment in their investigation of teacher beliefs, asking pre-service teachers to advise a colleague about their actions in an imagined teaching scenario. Accordingly, in this study, we opted for a scenario-based approach as a potentially valid method for exploring pre-service teachers' beliefs about student ability, sources of teaching knowledge, and teacher-efficacy. In doing this, we were inspired by similar attempts to use a scenario-based approach in related fields, such as epistemic beliefs and multiple-text comprehension (Barzilai and Weinstock, 2015; Sabatini et al., 2018; Lunn Brownlee et al., 2021; Wang et al., 2021).

The present study¹

Building on prior theoretical and empirical work focusing on teacher beliefs, as well as the assumption that practical, problem-based contexts (i.e., scenarios) may provide entry points for considered reflection (Hartmann et al., 2021), we implemented a scenario-based approach in studying pre-service teachers' beliefs about student ability, sources of teaching knowledge, and teacher-efficacy as they reasoned about authentic pedagogical problems. Specifically, we addressed the following research questions:

- (1) What beliefs do pre-service teachers hold about student ability, sources of teaching knowledge, and teacher-efficacy, as revealed by a scenario-based approach?
- (2) What do participants' responses to the scenarios reveal about their reliance on evidence from educational research to inform their decisions and actions?

¹ This study is part of a large longitudinal mixed methods project (Ferguson et al., 2022). However, the research questions, the materials, the analyses, and the results are all unique to this study and not reported elsewhere.

Materials and methods

Participants

Participants were 75 second-year pre-service teachers enrolled in 4-year teacher education programs at a public university college in southeast Norway (49 female, 26 male; $M_{age} = 21.10$, $SD = 4.22$). Eighty-nine percent of the participants had Norwegian as their first language and the rest were proficient in Norwegian. Participation was rewarded by entry into a prize draw for one of two gift cards (approx. USD 85) for shopping centers.

The teacher education programs followed national guidelines for teacher education (Norwegian Ministry of Education and Research, 2011) and consisted of 240 European Credit Transfer and Accumulation System (ECTS) credits. Sixty ECTS credits were allocated to Pedagogy and Pupil-Related Skills (PEL) class (often referred to as Education Studies in international literature; e.g., Guilfoyle et al., 2020). The remaining 180 ECTS credits focused on subject-specific (e.g., mathematics, Norwegian language, English as a foreign language) knowledge, skills, and general competences. For more detailed information about these teaching education programs, see Afdal and Spernes (2018).

Materials

Participants were presented with and responded to three scenario-based problem-solving tasks in writing (see Appendix A for the exact wording of each scenario). Scenario one described a sixth-grade classroom context in which students' performance on a natural science test varied greatly, and the participants were asked to discuss possible reasons for observed differences among students, with this discussion presumably reflecting their beliefs about students' ability, as well as other factors that might influence performance.

The second, two-part scenario was designed to capture participants' beliefs about sources of teaching knowledge and their reasoning about such sources. Based on the large variation in student performance noted in scenario one, participants were asked (a) to describe sources of knowledge they would use to design a new teaching sequence taking the large differences among students into consideration and (b) to justify their decisions.

Scenario three asked participants to imagine a future situation where they have become the science teacher of a challenging class. Participants were asked to discuss their possibilities to ensure a satisfactory learning outcome for all students in this class, based on their own strengths and weaknesses as a teacher. This task was designed to capture participants' beliefs about teacher-efficacy.

All scenarios were group-administered on paper and participants responded in writing. There were no time limit for reading or responding to the scenarios.

Data analysis

The thematic analysis of the scenario responses was both grounded in the data and informed by the authors' knowledge and interpretation of prior theoretical and empirical work on teacher beliefs, including work on beliefs about student ability, sources of teaching knowledge, and teacher efficacy (e.g., Dweck, 2000; Skaalvik and Skaalvik, 2014; Bråten and Ferguson, 2015; Guilfoyle et al., 2020). Please see Sections "Teachers' beliefs about student ability," "Teacher beliefs about sources of teaching knowledge," "Teacher-efficacy beliefs," for further discussion of the work that informed the authors' thematic analysis of the scenario responses. We applied a three-stage coding process in interacting with the data and relevant literature to explore and elaborate the emergent themes.

First, we studied anonymized participant responses for each scenario. Responses were segmented into units of analysis representing distinct and coherent ideas of varying extent. This means that the idea units could vary from a single word (e.g., the name of a specific source of teaching knowledge, such as "Internet") to a sentence or string of sentences that reflected participants' beliefs or reasoning.

We initially identified 176 idea units in response to the first scenario. Fifty-three (30%) of these idea units were hand coded by both authors, and the first author coded the remaining 123 idea units.

For the second scenario, 133 ideas were identified for the first part of the scenario, targeting participants' beliefs about sources of teaching knowledge. Forty-six (35%) of these were coded by both authors. Regarding the second part of the second scenario, asking participants to justify their choices of sources, 47 idea units representing reasoned justifications were identified, of which 12 (26%) were coded by both authors. Of note is that 30 participants failed to provide justifications for choices of sources but rather described their own teaching plans. While these ideas may reflect participants' beliefs and reasoning, their failure to provide sources for their thinking impaired our ability to make claims about these participants' reasoning and its sources (see limitations in the "Discussion" section).

For the third scenario, we identified 183 idea units referring to ways of teaching the challenging class, 46 idea units referring to strengths that might increase their chances of successfully teaching the new class, and 15 idea units referring to weaknesses that might hinder their success in this regard. Both authors coded 52 (28%), 22 (48%), and five (36%) idea units relating to ways of teaching, strengths, and weaknesses, respectively, and the remaining idea units were coded by the first author, consulting the second author whenever uncertainties were

encountered. Please note that while the units of analysis remained intact throughout the data analysis, some of the numbers were altered because categories were merged in the third step of the analysis. Whenever a percentage of the idea units was coded by both authors, the authors collaboratively read, segmented, and categorized those idea units, resolving any disagreements through discussion.

The first step of the data analysis, described above, involved multiple readings of each participant's responses and led to the creation of a set of precursory codes. As such, our preliminary analysis focused on fundamental, yet rather specific themes that emerged from the data, for example, specific ways of interacting with students (e.g., "use a strict tone," "be a clear leader," "show interest in pupils."). In the second step of the analysis, which also was collaborative, we therefore focused on identifying broader themes based on the preliminary analysis (for example, "classroom management," "relational approaches," "variation in teaching methods.>").

In the third step of the data analysis, participants' responses were transcribed and imported into NVivo. In NVivo, each of the emergent themes in step 2 became a parent node while the preliminary codes were represented by initial child nodes. Our use of NVivo increased the transparency of the data and allowed for further insight into the contents of each emerging theme, as well as comparison of parent and child nodes across the whole data set. This allowed us to re-examine the emerging themes and how they related to each other in terms of prevalence, as well as to gain more insight into the depths and variations within each theme and possible overlaps. To avoid redundancy, we also merged previously identified themes that were similar in content and formed meaningful sub-themes, for example with respect to types of motivation (e.g., "make the learning materials exciting" and "make teaching interesting" were both coded as "motivating approaches").

Given the nature of the questions, the three focal themes were: (1) teacher beliefs about students' ability, (2) beliefs about sources of teaching knowledge, and (3) beliefs about teacher-efficacy. However, our scenario-based approach and the rich nature of the resulting data also allowed for other emerging themes to be identified and provide information about participants' beliefs and reasoning.

Results

Participants enacted a range of educationally relevant beliefs in response to the three scenarios, including, but not limited to student ability, sources of teaching knowledge, and teacher-efficacy. We were also able to identify signs of (more-or-less) evidence-informed reasoning in their responses. The wording of the scenario-based problems also elicited justifications for participants' choices of sources of teaching knowledge (Scenario 2) and suggestions for a teaching approach based on perceived

strengths and weaknesses (Scenario 3). **Tables 1–5** include an overview of the emerging themes and sub-themes for each scenario, as well as illustrative idea units within those themes. In the following, we present an overview of the different emerging themes and also highlight variation within each theme.

Scenario 1

The first scenario focused on possible reasons for variation in student performance on a natural science test, designed to capture participants' beliefs about student ability (Dweck, 2000; Patterson et al., 2016). As can be seen in **Table 1**, we identified five emergent themes that concerned reasons for differences in student performance, which we labeled teaching, individual differences, motivational differences, sociocultural context, and test context. Moreover, each theme consisted of several sub-themes, which we also describe in this section. The most prevalent idea units ($n = 70$) reflected beliefs about the role of the teacher and aspects of their teaching practice in creating differences in student performance, encompassing the sub-themes of adapted teaching, management of teaching, and variation in teaching methods. Adapted teaching ($n = 44$) refers to the principle of adapted teaching, an approach which has a central position within the Norwegian egalitarian education system (Norwegian Ministry of Education and Research, 1999). For example, “that I, as a teacher, haven't adapted my teaching well enough,” “In this case I, as a teacher, haven't done a good enough job with evaluation, to pinpoint where all my students are in the knowledge acquisition process,” and “that the way I taught wasn't directed toward the whole class, but rather toward a smaller group that had more knowledge about the subject. The activities could have been set up on a more individual basis” were ideas falling within the sub-theme of adapted teaching. Management of teaching ($n = 15$) included ideas about the central role of the teacher in the students' learning process (e.g., “Perhaps one has failed to go through the topic in a thorough manner” and “It might be that the teacher hasn't explained the subject well enough”). Variation in methods ($n = 11$) refers to engaging in different teaching methods in class, for example, “if one has just been teaching from the blackboard then it may be smart to vary (teaching methods) more” and “Maybe the skewed results are caused by the fact that one has varied teaching methods too little. Maybe one needs to use other teaching methods to reach the whole class.”

Beliefs about individual differences were reflected in 53 of the idea units concerning differences in student performance. There were seven sub-themes referring to ability [$n = 15$; e.g., “there will be a variety of students with different talents and abilities in every class. Therefore, there is no ‘unnatural’ distribution (of results) here”], social and academic learning difficulties ($n = 15$; e.g., “there may be trouble at the social level, personal problems, illness etc.”) and “There may be reading and

writing difficulties in this group of students”), concentration ($n = 7$, e.g., “the differences may be because not everyone has managed to concentrate on the teaching”), time needed to learn ($n = 7$, e.g., “some people take longer time before they understand the curriculum”), learning styles [$n = 5$; e.g., “Some students learn best with an auditive learning style, some (are) more visual and some more tactile”], learning strategies [$n = 2$; e.g., “Many (students) do not know which working methods suit them best and study for a test by reading from the start to the end of the chapter”], and maturity ($n = 2$; e.g., “the students are at different levels of maturity. They don't develop at the same tempo”) as reasons for differences in student performance on the science test.

Beliefs about motivational differences were reflected in 42 idea units. Within this theme, there were six sub-themes: Individual interest, effort, situational interest, general motivation, willingness to learn, and goal-orientation. Individual interest ($n = 15$) focused on students' levels of intrinsic interest as a reason for differences in performance, for example, “It may also be caused by interest, the five students who have been (i.e., scored) extremely poorly are not so into the topic, while the five who have performed well think the topic is interesting.” Effort ($n = 13$) concerned investment of personal resources in the time preceding the test, for example, “effort before the test” and “It may also be that some of the students didn't “bother” to read - that this is the reason for the poor results.” Situational interest ($n = 7$) is regarded as more contextualized and transitional than is individual interest (Hidi, 2001). From participants' responses, it seems that more emphasis was placed on the teacher's effort in sparking situational interest (i.e., in comparison to individual interest), for example, “whether one (the teacher) has made it interesting enough to engage everyone” and “(the teacher) hasn't awakened enough “nosiness” in their students.” General motivation ($n = 4$) ideas were broad references to “motivation” without any further specification, such as “motivation . . . probably has a lot to say.” Willingness to learn ($n = 2$) were specific statements referring to a will to learn, such as “another factor can also be the students' own will to learn.” Finally, goal-orientation ($n = 1$) concerned (the lack of) students' engagement with learning goals specified by the teacher: “It may also be the case that the students just don't care about achieving the specified goals.”

The 21 idea units reflecting beliefs about the sociocultural context could be categorized into the sub-themes of home situation, resources and equipment, and classroom culture. Home situation ($n = 14$) referred to support, interest, and pressure from the students' families, for example, “Help and being followed up at home also play an important role” and “whether they have parents who can push their children to read extra.” Resources and equipment ($n = 4$) concerned both teaching resources and students' physical placement in the classroom, for example, “This is mainly caused by a lack of time and resources for the individual students” and “equipment, etc.

TABLE 1 Emergent themes, sub-themes, and illustrative idea units based on responses to Scenario 1.

Emergent theme	Sub-themes	Illustrative idea units
Teaching ($n = 70$)	Adapted teaching ($n = 44$), management of teaching ($n = 15$), variation in teaching methods ($n = 11$)	Other students have perhaps not gotten the adapted teaching that they need, and have therefore not benefited from teaching that has been the same across the board for the whole class (S104); It might be that the teacher hasn't explained the subject well enough (S27); Had the teacher maybe tried to vary the teaching (S71).
Individual differences ($n = 53$)	Ability ($n = 15$), learning difficulties ($n = 15$), concentration ($n = 7$), time to learn ($n = 7$), learning styles ($n = 5$), learning strategies ($n = 2$), maturity ($n = 2$)	In every class there are a variety of students with different abilities and starting points (S7); The differences may be because not everyone has managed to concentrate in class (S16); For example, specific reading or writing difficulties (S15); Some may have diagnoses, language difficulties, etc. that stop them from learning so much (S48).
Motivational differences ($n = 42$)	Individual interest ($n = 15$), effort ($n = 13$), situational interest ($n = 7$), general motivation ($n = 4$), willingness to learn ($n = 2$), goal orientation ($n = 1$)	Motivation is also a big factor here (S43); Students who did badly may have problems with motivation and interest for the topic or subject (S91).
Sociocultural context ($n = 21$)	Home situation ($n = 14$), resources and equipment ($n = 4$), classroom culture ($n = 3$)	A culture for doing one's best has not been established, and there is no culture for creating a sense of wonder (S9); Help and support at home also play an important role (S34); I think students' placement in the classroom can have a lot to say. Some students perhaps need to sit closer to the board to see. . . (S100).
Test context ($n = 15$)	Test preparation ($n = 8$), test difficulty ($n = 7$)	It's possible that the test wasn't targeted to different levels (of ability) (S32); That the questions on the test were formulated in a difficult way (S16); As teacher I should give notice 1 week in advance so that students can prepare (S21).

Numbers refer to idea units within each emergent theme and sub-theme. S followed by a number refers to a particular participant.

TABLE 2 Emergent themes, sub-themes, and illustrative idea units based on responses to Scenario 2.

Emergent theme	Sub-themes	Illustrative idea units
Informal ($n = 58$)	Colleagues ($n = 31$), students ($n = 14$), own resources ($n = 12$), family and friends ($n = 1$)	I would discuss with my colleagues. . . Maybe I can get some colleagues to observe my lessons to see what I can do better and what I have to change (S5); Initially I would ask students how they thought they learned best (S20).
Formal ($n = 32$)	Textbooks and educational literature ($n = 29$), teacher education ($n = 2$), research ($n = 1$)	I would have checked books from teacher education curriculum (S78); Old textbooks (S53).
Digital media resources ($n = 28$)	–	Relevant internet pages such as: smartskole.no (https://www.smartskole.no/) (SmartSchool.no) (S25); nrk.no (national broadcasting company) (S28); nettartikler (internet articles) (S42); films on YouTube (S49).

Numbers refer to idea units within each emergent theme and sub-theme. S followed by a number refers to a particular participant.

TABLE 3 Emergent themes, sub-themes, and illustrative idea units based on responses to the second part of Scenario 2.

Emergent theme	Sub-themes	Illustrative idea units
Gaining new ideas and inspiration for own consideration ($n = 13$)	–	In order to gain more perspectives on how to awaken interest in students (S3); I would use the internet to get ideas (S29).
Others' experiences ($n = 10$)	–	As a rule, they will find themselves in similar situations and have tried out different tasks in their own classes (S29); they talk from experience (S45).
Specific answers and pre-prepared exercises ($n = 9$)	–	You can find good to go exercises for smartboard use (S25). If I didn't have any answers, I would check the internet or ask friends/family (S53).
Research-based or professional knowledge ($n = 2$)	–	To gather some professional material about the subject (S42).
Other pedagogical justifications ($n = 13$)	Student participation ($n = 5$), academic adaption ($n = 3$), concretization ($n = 2$), variation ($n = 2$), accessibility ($n = 1$)	To connect (the subject and learning materials) to news and facts that are relevant for students and their everyday life (S51).

Numbers refer to idea units within each emergent theme and sub-theme. S followed by a number refers to a particular participant.

TABLE 4 Emergent themes, sub-themes, and illustrative idea units based on responses to Scenario 3: Approaches to teaching the challenging class.

Emergent theme	Sub-themes	Illustrative idea units
Adapting instruction ($n = 114$)	Formal and informal evaluation ($n = 31$), academic adaption ($n = 27$), organization of instruction ($n = 23$), variation ($n = 19$), motivating approaches ($n = 11$), flexibility of homework ($n = 3$)	First I would give a test to check the academic level. Converse with the class about what kind of teaching works for them (S15).
Classroom management ($n = 43$)	Classroom environment ($n = 24$), leadership ($n = 19$)	It is important to set clear rules for what is allowed in class, and make clear demands of students (then everyone feels that they have been seen) (S5); Create a good and secure classroom environment (S90).
Social interactions with students ($n = 31$)	Relational approaches ($n = 13$), teacher's way of being ($n = 9$), student participation ($n = 6$), formal and informal evaluation of social competence ($n = 3$)	It would be important for me to get to know all of the pupils well, so that I would know how they work and "have more strings to play on" (S4).
Cooperation with parents and colleagues ($n = 2$)	Collaborate with parents, collaborate with colleagues	Try to collaborate with parents to make sure that the majority of students are supported at home (S20); Ask for a classroom assistant (S40).

Numbers refer to idea units within each emergent theme and sub-theme. S followed by a number refers to a particular participant.

TABLE 5 Emergent themes, sub-themes, and illustrative idea units based on responses to Scenario 3: Strengths and weaknesses as a teacher.

Emergent theme	Sub-themes	Illustrative idea units
Positive personal characteristics ($n = 29$)	Humanistic views ($n = 8$), patience and calmness ($n = 6$), warmth, kindness, and openness ($n = 5$), creativity ($n = 4$), communication skills ($n = 4$), all-rounder ($n = 2$)	"... I appreciate all children and believe there is good in everyone..." (S4); I am patient, which can be useful (S49).
Mastery of tasks ($n = 9$)	Pedagogical competence ($n = 8$), mastery of subject matter ($n = 1$)	My strengths as a teacher are that I can assess their academic level and guide them on their way (S73); I would have a lesson plan and the knowledge to answer nearly everything they wonder about (S23).
Personal weaknesses ($n = 4$)	Lack of experience or efficacy	My weakness is that I panic when I don't know how to handle a situation, especially when the situation is new for me (S83); I feel this could be difficult, as I am still young and relatively uncertain (S100).
Task-related weaknesses ($n = 11$)	Lack of structure ($n = 8$), lack of knowledge ($n = 3$)	I don't know the class, that could be a weakness (S37), I am not very good at being an authoritarian (teacher) (S55).

Numbers refer to idea units within each emergent theme and sub-theme. S followed by a number refers to a particular participant.

has a meaning." Also, classroom culture ($n = 3$) was highlighted as a possible reason for differences in student performance, for example, "There is no culture for doing one's best in the classroom."

Finally, test context ($n = 15$) was believed to be a reason for the differences in student performance. The ideas that fell into this theme concerned aspects of the test and the testing. The sub-themes were test preparation and test difficulty. Test preparation ($n = 8$) reflected the view that the teacher had given too short notice of the test (i.e., 3 days), for example, "I, the teacher, should give notice 1 week in advance so the students can get prepared." Test difficulty ($n = 7$) concerned the wording of the test questions and the academic level of the test, for example, "that the questions in the test were formulated in a difficult manner" and "Maybe the test was too demanding for the students."

Scenario 2

The second scenario was designed to target participants' beliefs and reasoning about sources of teaching knowledge

by asking them to consider where they would gather ideas for a teaching plan in a natural science class and how they would justify their decisions. Participants expressed a range of ideas about sources of knowledge that were captured by three main themes (see Table 2). Notably, an overweight of the ideas ($n = 58$) reflected a reliance on informal and craft-based knowledge sources, while 32 ideas reflected a reliance on more formal, evidence-informed sources of teaching knowledge. There were also 28 idea units that indicated reliance on digital media resources located on the Internet.

Informal and craft-based sources of teaching knowledge contained the sub-themes of colleagues, students, own internal resources, and family and friends. Colleagues ($n = 31$) emerged as a particularly prevalent knowledge source for the participants, and it was evidenced in idea units such as "I would discuss with my colleagues... Maybe I can get some colleagues to observe my lessons to see what I can do better and what I should change... It might be an idea to observe other teachers in their teaching for inspiration" and "As a new teacher, I can talk to more experienced teachers." Students ($n = 14$) were also considered a source of knowledge for our participants,

for example, “I could have talked to the students to find out which methods they would learn most from” and “ask the students how they want the lessons to be.” Participants’ own experience, knowledge, thinking, reasoning, and creativity were categorized together to form a sub-theme ($n = 12$) indicating reliance on their own, internal resources, exemplified by “earlier experiences” and “I would use elements of the earlier lesson that had proven to be good and discard the parts that didn’t work.” Discussion with family and friends whilst being observant of student confidentiality, was also a suggested source ($n = 1$).

Within more formal sources of teaching knowledge, textbooks and educational literature ($n = 29$), teacher education ($n = 2$), and research ($n = 1$) were identified as sub-themes. Textbooks and educational literature included subject specific and education textbooks, teacher guides, and the national curriculum, for example, “I would look to relevant literature on learning strategies,” “I would have used the book from education studies,” and “I would also look at the goals from the core curriculum in the upcoming topic.” Teacher education was referenced infrequently (e.g., “and from teacher education”), and research only featured in one of the participants’ responses (“If someone has researched this, then it is interesting to see what results they attained”).

Finally, digital media resources located on the Internet can be exemplified by “maybe I could have found some suggestions on the internet” and “find good and complete teaching plans for smartboard.” There were also references to specific webpages, for example <https://www.nrk.no/> (the national broadcasting company; see [Table 2](#)).

Of note is that a number of the participants ($n = 30$) failed to answer the question of where they would gather ideas for the teaching plan, simply presenting their own suggestions for such a plan. Since the participants were explicitly asked to provide the sources of their ideas, these responses were considered invalid in the context of this study and will, therefore, not be presented.

In the second part of Scenario 2, participants were asked to give reasons for their choices. Forty-seven idea units were identified, with eight students responding to the first part of the scenario failing to respond to the second part (i.e., not justifying their suggested sources of knowledge). The responses referred to four knowledge-related justifications: gaining new ideas and inspiration in order to consider these and use them as they wished ($n = 13$), testimony/others’ experience, mainly referring to colleagues ($n = 10$), looking for specific answers and pre-prepared exercises ($n = 9$), and using research-based or professional knowledge as evidence ($n = 2$). There was also one category of responses (other pedagogical justifications, $n = 13$) that referred to pedagogical principles such as academic adaption and variations as justifications.

The most common justification, gaining ideas and inspiration, focused on getting suggestions for classroom practice, with references to “gathering more perspectives” that could be adapted in the way participants wished (e.g., “in

this way I could see who learns from what... and arrive at something that works”). References to similar situations and experience-based knowledge were, not surprisingly, common justifications, with experienced colleagues given particular importance [e.g., “if they’ve gone through the curriculum (on this topic) before”]. Participants were also interested in finding solutions and pre-prepared, perhaps tried and tested, exercises from the internet and textbooks, perhaps suggesting a lack of motivation to use evidence to make reasoned decisions about their teaching (e.g., “there are lots of good exercises on the internet”). There were sparse justifications referring to the need for professional (i.e., evidence-informed) knowledge (gathering professional materials on the topic). Finally, participants also failed to provide epistemic justifications for their choice of sources of teaching knowledge, rather referring to pedagogical reasons for their choices. Sub-themes in the emerging theme of pedagogical justifications referred to student participation, academic adaption, variation, and accessibility, for example “it is important to vary teaching,” “because the students have easy access to these (sources).”

Scenario 3

The third scenario was designed to capture participants’ beliefs about their perceived efficacy by asking them to consider their chances for ensuring a satisfactory learning outcome for all students in a challenging class, taking their own strengths and weaknesses as a teacher as a point of departure. For this scenario, a large proportion of the participants ($n = 69$) detailed specific approaches they would use. We identified the four main themes of adapting instruction ($n = 114$), classroom management ($n = 43$), social interactions with students ($n = 31$), and co-operation with parents and colleagues ($n = 2$). These main themes and their respective sub-themes are presented and exemplified in [Table 4](#).

Approaches that were coded as adapting instruction consisted of six sub-themes: Formal and informal evaluation of student knowledge and learning preferences ($n = 31$), academic adaption ($n = 27$), organization of instruction ($n = 23$), variation ($n = 19$), motivating approaches ($n = 11$), and flexibility and homework ($n = 3$). Formal and informal evaluation of student knowledge and learning preferences was mainly concerned with students’ academic strengths and weaknesses, but also with preferences in terms of learning strategies and teaching methods, for example, “What is it that the students think is challenging? What do students think about this subject? I would start by asking this kind of question to find out more about them” and “What do they find difficult and which methods do they think work for them?” Building on such processes of evaluation, many participants highlighted the importance of adapted education, for example, “Make the topic a little more concrete and directed toward everyday life” and “I would

have gone through the materials thoroughly with the class, and thereafter maybe let them work with tasks that are adapted to each individual.” Organization of instruction referred to specific ways of working with the challenging class, for example, “I would have taken the students on a lot of excursions” and “Here I would have to try out different exercises, forms of teaching, and so on. When I eventually learn what works and not, I would go for more of those methods.” Variation for variation’s sake was also reflected in quite a few idea units, such as “I would also vary the teaching, so that the students could get to see several sides of me.” Motivating approaches were directed toward fun, interest, and mastery, for example, “I would therefore use creativity to make the teaching more fun and exciting.” Finally, a few idea units referred to flexibility and homework as approaches (e.g., “. . . something they have prepared at home. In my time at school, I have also seen that giving homework is usual and can help on tests.”

Beliefs about classroom management consisted of idea units focusing on class environment ($n = 24$) and class leadership ($n = 19$). Class environment concerned the culture within the classroom, social competence, and attitudes, as well as security, for example, “Show the students that each and every one is seen every day and be a secure (adult)” and “tried to have a good dialog with the students continually, so that I know what the students’ expectations of me are.” Class leadership was more related to a strict tone in the classroom, being a clear leader, and establishment of clear rules. The aspects of leadership seemed to be tightly linked to one another, for example, “when I come into this class, it will be important for me to show who I want to be as an adult and leader for them and what I expect from them” and “Keep quite a strict tone.”

The emergent theme termed social interactions with students focused primarily on emotional and relational aspects of teacher-student interactions, and the sub-themes concerned relational approaches ($n = 13$, e.g., “and form good relations with the students” and “let them get to know me”), teacher’s way of being ($n = 9$, e.g., “The absolute first thing I would do is to go into this class without too many prejudices. Everyone deserves a chance with me as a new teacher”), student participation ($n = 6$, e.g., “It is also important to get input from the students and take these into consideration”), and formal and informal evaluation of social competence ($n = 3$, e.g., “In this class I would use a lot of time getting to know them. Find out what they like, also out of school”).

Finally, two idea units reflected beliefs about co-operation with parents (“tried to collaborate well with the parents, so that as many of the students as possible were being attended to at home”) and colleagues (“perhaps ask for an assistant at the start”).

With respect to participants’ perceived strengths and weaknesses in relation to teaching the challenging class, we identified two emerging themes representing beliefs about strengths (viz., positive personal characteristics and mastery

of tasks) and two emerging themes representing beliefs about weaknesses (viz., personal weaknesses and task-related weaknesses). These main themes and their respective sub-themes are presented and exemplified in [Table 5](#).

Idea units concerning positive personal characteristics ($n = 29$) could be categorized into six sub-themes: holding humanistic views and appreciating personal differences ($n = 8$, e.g., “That I appreciate all children and think that everyone has some good in them is an advantage”); patience and calmness [$n = 6$, e.g., “my strength in the classroom is that I am calm and this can be “infectious” (i.e., spread widely) in the class”]; warmth, kindness, and openness ($n = 5$, e.g., “I think I would get to know the class quickly, I am good at being open”); creativity ($n = 4$, e.g., “I am a creative person”); communication skills ($n = 4$, e.g., “That I am a clear leader also helps”); and being “all-rounders” ($n = 2$, e.g., “My strength is all-roundedness”). Idea units concerning mastery of tasks ($n = 9$) referred to pedagogical competence ($n = 8$, e.g., “I am good at adapting my teaching, so I know that everyone has a good learning outcome from my lessons” and “My strengths as a teacher are that I can evaluate their level and support them on the way”) and mastery of subject matter ($n = 1$, “I will have the knowledge to answer almost anything they might wonder about”).

Regarding weaknesses participants believed could hinder their ability to help all students learn ($n = 15$), personal weaknesses ($n = 4$) focused on lack of experience or efficacy, for example, “My weakness is that I panic when I don’t know how to handle a situation, especially if the situation is new for me”). Finally, task-related weaknesses included lack of structure ($n = 8$, e.g., “From time to time I am easy to get to digress” and “My biggest weakness is that I might get carried away with myself if I think something is more interesting than the students do”) and lack of knowledge about the subject or the students ($n = 3$, e.g., “I don’t know the class, which might be a weakness”).

Discussion

In this study, we introduced problem-based contexts to gain insight into second-year pre-service teachers’ beliefs about student ability, sources of teaching knowledge, and teacher-efficacy. We also aimed to investigate what participants’ responses revealed about their reliance on educational research as a means of informing their pedagogical decisions and actions, given that researchers and teacher educators have highlighted a lack of evidence-informed decisions and actions among teachers and student teachers (Bråten and Ferguson, 2015; Guilfoyle et al., 2020; Kiemer and Kollar, 2021).

Our findings align with prior research (Fives and Buehl, 2008; Bråten and Ferguson, 2015; Ferguson et al., 2022) but also provide new insight by merit of participants’ responses to scenarios and their reasoning about the described problems. In particular, the pre-service teachers’ beliefs about student

performance actually placed most emphasis on the role of the teacher, their actions, and the ways they interact with students and adapt and vary their teaching methods and exercises. While taking the importance of their role to heart is, indeed, important, it is also relevant that the future teachers appreciated that students present themselves with individual differences in terms of ability, learning difficulties, and focus on learning. However, it is somewhat discouraging that beliefs in learning styles also feature prominently in the minds of some of our participants and are used to explain individual differences among students.

In terms of student motivation, our participants' beliefs seemed evidence-informed with respect to multiple motivational variables, such as interest, effort, and goal-orientation. While previous studies have found that inexperienced teachers tend to think of motivation in terms of a unidimensional construct that is, or is not, present in students (Patrick and Pintrich, 2001), participants in this study seems to hold more nuanced beliefs (see also, Ferguson and Bråten, 2018). Moreover, participants considered contextual factors such as the sociocultural background and context of students' learning and aspects of the test that featured in the scenario. Thus, our findings aligned with previous research by Patterson et al. (2016), which identified school, family, and student factors relating to teachers' beliefs about student performance. However, participants in this study seemed more focused on their own responsibility, given the prevalence of the category of teaching in the responses to Scenario 1. While it is neither uncommon for new teachers to have more focus on their own behavior than that of their students, nor unwarranted, given supporting evidence (Hattie, 2012), it may also be important for teacher educators to help pre-service teachers focus on other (important) factors that influence student performance, to help avoid teacher burnout in the long run (Skaalvik and Skaalvik, 2007).

Concerning the findings relating to the second scenario, about sources of teaching knowledge and participants' justifications for their choices, the categories of responses may be somewhat unsurprising, disappointing even, since most participants opted to rely on informal knowledge sources such as experienced colleagues, and since participants hardly referred to educational research at all, neither as sources of teaching knowledge nor when justifying their choice of sources. In general, participants' beliefs about sources of teaching knowledge therefore could not be considered consistent with or conducive to evidence-informed reasoning about sources of teaching knowledge and their justification. However, the nature of our data and the scenario-based approach allowed for added insights such as the ways in which the participants intended to use sources of knowledge. Although they were intent on finding out what colleagues might do in similar situations, they also signaled considerable independence in these situations. That is, participants intended to gain colleagues' perspectives as one of

several views, sometimes also including student perspectives or knowledge from educational literature as other sources of teaching knowledge. While some of our participants were interested in finding readymade teaching exercises, it is difficult to draw further conclusions as to how the pre-service teachers intended to use these sources, since this was not elaborated in participants' responses.

Regarding participants' responses to the third scenario, designed to assess teacher efficacy, they detailed specific approaches to ensuring satisfactory learning outcomes in a challenging class before discussing their chances of success in light of their own strengths and weaknesses as a teacher. The four main themes of adapting instruction, classroom management, social interactions with students, and co-operation with parents and colleagues may be mapped on to measures of teacher-efficacy that are designed to reflect the multi-dimensional nature of teachers' work (Tschannen-Moran and Hoy, 2001), as well as the aims of the Norwegian national curriculum and school reforms (Skaalvik and Skaalvik, 2007).

Teacher-efficacy may be influenced by the factors that teachers view as important in influencing student performance. Thus, the pre-service teachers in this study who regarded factors relating to the teacher as being important for student performance may have had higher teacher-efficacy than those who focused more on internal student factors (individual differences) and socio-cultural differences relating to, for example, home circumstances (Skaalvik and Skaalvik, 2007). This is because factors relating to the teacher may support their experience of being able to exert effort and behaviors that influence student outcomes, compared to factors that are more out of their control. Further, the personal characteristics and task-related strengths and weaknesses that were highlighted by participants seemed more-or-less evidence-informed. As such, they adequately referred to aspects of teaching knowledge and experience, although a few of the responses concerning personal characteristics also suggested that views of certain characteristics of teachers as innate, rather than learned, still exist. Such responses were sparse, however, and perhaps somewhat ambiguous as they did not reveal the underlying mechanism of growth vs. fixed views (Dweck, 2000).

In sum, the results from this study uniquely contribute to the literature by showing the nuances of teacher beliefs about student performance, sources of teaching knowledge, and teacher-efficacy, and they provide further insight into pre-service teachers' limited consideration of research as evidence in pedagogical decision-making. We believe that our study has both methodological and theoretical implications in addition to its importance for practice.

Our study used a methodological approach that provides a more contextualized understanding of teachers' beliefs and, thus, can be assumed to generate more valid responses than those typically generated by asking participants to rate their beliefs on a questionnaire (Schraw and Olafson, 2015). However,

our study also highlighted that pre-service teachers, despite the scenario-based approach, may find it somewhat difficult to explain and justify the sources of teaching knowledge that they draw on. More generally, teacher beliefs may often be tacit and difficult to articulate, and more research is needed on the relation between tacit beliefs and teaching practice, as well as on how future teachers can be helped to articulate their beliefs. Our results may also raise issues concerning the nature of evidence in teacher knowledge and educational research, and the extent to which empirical, experimental data may have to be supplemented with more ecologically valid studies that probe teacher thinking. For example, such studies may ask teachers with more and less experience to think aloud to determine how knowledge sources are actually used and how teachers try to integrate theory and practice.

Hopefully, the picture of teacher beliefs that we have painted in this study may help teacher educators understand pre-service teachers' beliefs and help them develop availing beliefs in teacher education (Sugrue, 1997; Schraw and Olafson, 2015; Lunn Brownlee et al., 2016; Mor-Hagani and Barzilai, 2022). Further, it may help teacher educators correct misconceptions among pre-service teachers that are detrimental to their own and their future students' learning (Menz et al., 2021), as well as to nurture their tendency to engage in evidence-informed practice (Buehl and Beck, 2015; Csandi et al., 2021; Hendriks et al., 2021). Working with pre-service teachers' beliefs in teacher education may also help future teachers think about concrete situations in terms of more abstract, theoretical, and evidence-informed sources of teaching knowledge, rather than acting on gut-feeling or (unexamined) habits (Csandi et al., 2021; Kiemer and Kollar, 2021; Spernes and Bjordal, 2022). In particular, our study may inform teacher educators about the nuances of beliefs they may encounter in teacher education programs, and how those beliefs may be consistent with what they teach in the programs but also take the form of some stubborn misconceptions (Menz et al., 2021) that need special attention. Changing such misconceptions may require extensive modeling and scaffolding by teacher educators who open up their own teaching beliefs and practices to demonstrate the evidence-base they employ in their teaching, and how it aligns with their educational beliefs (Ferguson, 2021).

Limitations and future research

A limitation of the present study is the nature of participants' succinct answers to the scenarios, with think-aloud data presumably allowing for firmer conclusions regarding participants' reasoning and use of evidence, in particular. Presumably, more ecological validity could also have been achieved by having pre-service teacher complete learning logs or observing them in action. However, our methodological approach was less invasive for our participants

(and their students) and had no potential negative real-life consequences. In future research, a scenario-based approach may be extended by use of video cases or scenarios that can be discussed collectively and with the added advantage of time to reflect. Also, real-life examples may be presented as a starting point for discussions of theoretical constructs, characteristics, and teacher moves (Csandi et al., 2021; Spernes and Bjordal, 2022).

Of note is also that the themes emerging from the data and interpreted by the researchers, of course, do not contain exhaustive lists or possibilities when it comes to (pre-service) teachers' beliefs or reasoning. This is related to the content of the scenarios that we created. Although these three scenarios were designed to capture beliefs and reasoning about student ability, sources of teaching knowledge, and teacher efficacy, respectively, the hypothetical problem contexts they represented also might have been more or less likely to elicit evidence-informed thinking drawing on relevant educational research. For example, whereas the second scenario, in particular, may have provided valuable information about participants' evidence-informed reasoning (or the lack of it), the third scenario might have been better suited to activate participants' self-perceptions or self-evaluations than their reasoning about the usefulness or relevance of educational research. In future studies, it therefore seems important to both broaden the scope of the scenarios and ensure that they are equally well suited to reveal evidence-informed reasoning (or the lack of it) on the part of the participants. In this way, it may also be possible to maintain a clearer, more distinct focus on evidence-informed reasoning in analyzing and reporting scenario-based data, rather than focusing on beliefs and exploring to what extent these beliefs might or might not align with evidence-informed reasoning about educational issues, as we did in the current study. We acknowledge that it could be regarded as a limitation of this study that the data we collected did not lend themselves to a clear differentiation between beliefs and reasoning in participants' responses to the scenarios, with the signs of evidence-informed reasoning (or the lack of it) that we were able to identify being interwoven with participants' beliefs about student ability, sources of teaching knowledge, and teacher-efficacy.

Further, our data collection was a one-shot event in two particular programs of teacher education. What we were able to gain is therefore a snapshot in time of pre-service teachers in two teacher education programs in Norway that could be extended by conducting data collection at multiple time points taken throughout the teacher education period across different programs. As such, much more research is needed to obtain deeper insights into teacher beliefs and reasoning over time and in different contexts. Finally, we would like to highlight the need for more qualitative investigations into the mechanisms that connect teachers' beliefs and their (evidence-based) reasoning.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

This study was exempt from ethical approval procedures since no sensitive or identifying data was collected and the study was anonymous. The patients/participants provided their written informed consent to participate in this study.

Author contributions

Both authors designed the study, analyzed the data, wrote the manuscript, and had worked on the final version of the

manuscript. LF completed the data collection and prepared the first draft of the manuscript. IB revised the manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Appendix A

The teaching scenarios

You are about to answer three questions. Read each task carefully and take the time you need to answer thoroughly.

Question A: You are teaching a 6th grade natural science class. The class consists of 22 students, 10 boys and 12 girls. After working with the topic “the human body,” you set a class test on that chapter. The class received 3 days notice about the test. The test results show that five students completed all tasks correctly, while five students performed very poorly on the test. The test performance was average for the rest of the class. Discuss reasons for these great differences in students’ learning outcomes. Answer the question as fully as possible. Use the time you need to reflect when you respond.

Question B: You are now going to create a teaching plan for the next topic in natural science class that takes into consideration the great differences in student learning outcomes that were apparent on the last test. Where will you gather ideas for this teaching plan? Give reasons for your choices.

Question C: Imagine a year has passed. You are now teaching a new 6th grade class in natural science. This class is known for being the school’s most challenging class to teach. You have taken over as form teacher for this class since their previous form teacher has retired. Discuss your chances of being able to ensure a good learning outcome in natural science for all the students in this class—taking your own strengths and weaknesses as a teacher as a point of departure.