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Do Student Teachers Have Domain-Specific Beliefs About Talent? An Intra- and Inter-Individual Comparison

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Abstract

This study examines the nature of talent beliefs among student teachers. As teacher beliefs are linked to disciplinary content and teacher identity, understanding if these beliefs are influenced by specific domains is important to shaping future teacher education. To assess this, 215 student teachers from two Austrian Universities were surveyed, including 43 mathematics and 93 language majors. The results show intra-individual differences for beliefs about mathematics and verbal talents and inter-individual differences for beliefs about mathematical talents across math and language participants. However, this was not the case for beliefs about verbal talent. Future studies should consider examining domain-specific talent beliefs and their predictive effects on teaching quality.

Keywords: talent beliefs; domain specificity; mathematical giftedness; verbal giftedness; student teachers

1. Introduction

Research on teacher beliefs has been central to the education community for at least 50 years (Patterson et al., 2016), although there is no general agreement on defining the term (Fives & Buehl, 2012; König, 2012; Pajares, 1992; Thompson, 1992). The widely referenced definition by Richardson (1996, p. 103) is that teacher beliefs are "understandings, premises, or propositions about the world that are felt to be true". Most studies on teacher beliefs focus on their influence on students' academic performance (Patterson et al., 2016). However, a wide variety of studies have focused on this topic. Notable among them are those by Asbury et al. (2023), Bönke et al. (2024), Kehl et al. (2024), Olivos and Yuan (2023), and Xu and Krulatz (2023). These studies examined teacher beliefs across a range of cultural contexts, applying a variety of research methods and considering different perspectives.

In this study, we analyze teacher beliefs about giftedness and talent—teacher talent beliefs—considering the influence of specific domains. Universal teacher talent beliefs are relevant, as they influence teaching quality, teaching and learning processes, learning environments, motivation, and student performance (Matheis et al., 2017; Missett et al., 2014; Rattan et al., 2012; Rogl, 2022; Rutigliano & Quarshie, 2021; Tofel-Grehl & Callahan, 2017). This study makes a valuable contribution to the literature by offering a detailed examination of talent beliefs, focusing on domain specificity. This approach addresses the gap in our understanding of how talent beliefs vary by domain. We aim to explore whether student teachers have different talent beliefs in the domains of verbal and mathematical giftedness. If this is the case, such beliefs can be addressed in teacher education and further education in a more differentiated way.

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This article takes a closer look at the concept of giftedness according to student teachers, as well as their beliefs behind giftedness and talent in combination with certain school subjects and domains. A brief introductory look at the research discourse aims to explain the scientific and research position. Terms such as "Babylonian language confusion" (Ziegler, 2008, p. 14) or "Fuzzy concept" (Schneider, 2017, p. 171) already show the lack of consensus within the field of gifted education research. The lack of a standardized definition of giftedness and talent is criticized or seen as a methodological challenge in gifted education research (e.g., Carman, 2013; Stöger et al., 2018; Subotnik et al., 2011). A considerable number of giftedness and talent development models and theories can be found in numerous handbooks and overviews (e.g., Dai, 2018a, 2018b; Pfeiffer et al., 2018; Ziegler, 2008). The variations and range of explanations and definitions are diverse and sometimes contradictory. There are disagreements regarding single or multiple domains of giftedness; there are also conceptual ranges from genetic predisposition to environmental influences (Stöger et al., 2018). Stöger et al. (2018), for example, provide an overview of the diversity in the understanding and use of terms such as talent, giftedness, talented person, or gifted person. Dai (2018a, 2018b), Dai and Chen (2013), and Subotnik et al. (2011) argue in their review articles for a dynamic approach to talent development, with increasing differentiation and diverse development paths, in order to explain the phenomena of giftedness and outstanding performance. In the following passage, Subotnik et al. (2011) describe the construct of giftedness and also locate the terms talent, potential, eminence, etc., in line with current research and the understanding of this article.

> Giftedness is the manifestation of performance or production that is clearly at the upper end of the distribution in a talent domain, even relative to that of other high-functioning individuals in that domain. Furthermore, giftedness can be viewed as developmental, in that in the beginning stages, potential is the key variable; in later stages, achievement is the measure of giftedness; and in fully developed talents, eminence is the basis on which this label is granted. Psychosocial variables play an essential role in the manifestation of giftedness at every developmental stage. Both cognitive and psychosocial variables are malleable and need to be deliberately cultivated. (Subotnik et al., 2011, p. 7)

2. Literature Review

Studies on teacher talent beliefs encompass a variety of research designs and belief concepts. Epistemological beliefs considering their dynamic versus static nature, as well as teaching- and learning-related beliefs, have been analyzed through both qualitative and quantitative methods. For example, some studies have focused on implicit beliefs concerning entity theories of intelligence and their impact on teaching methods, abilities, and expectations of student performance (Rattan et al., 2012). Others have examined teacher talent beliefs about gifted student characteristics arising between the mad genius stereotype and the disharmony hypothesis (Baudson & Preckel, 2013, 2016). Baudson and Preckel (2013) provide an overview of evidence from longitudinal, cross-sectional, and review studies on the gifted (e.g., Benbow and Lubinski's study of Mathematically Precocious Youth, the Terman study, or the Marburger study by Rost) to prove the facts behind the harmony hypothesis. Disharmonic teacher talent beliefs, associating maladjustment with giftedness, are also linked with lower enthusiasm and self-efficacy, as Matheis et al. (2017) demonstrated in their study with preservice teachers. Teacher talent beliefs guide teachers' perceptions of teaching and learning processes, or direct planning lessons. They are evaluative and affective, with emotional, normative, and subjective aspects. In addition to these filters with guiding and framing functions, they represent knowledge, such as giftedness and talent development (Rogl, 2022). As beliefs are closely linked to the subject

being taught, disciplinary content, pedagogy, and teacher identity, the question arises as to whether beliefs are influenced by specific domains.

2.1. Domain-Specific or Universal?

Broadly, teacher talent beliefs are measured using generalized items (Gagné, 2018; McCoach & Siegle, 2007; Troxclair, 2013), sometimes including specific questions covering modifiability (incremental versus entity implicit theory), a growth-versus-fixed mindset (Dweck, 1986, 1998, 1999, 2008; Dweck et al., 1995; Dweck & Leggett, 1988), or stereotypes (disharmony versus harmony hypotheses) (Baudson, 2016; Baudson & Preckel, 2013; Preckel et al., 2015). Even though teacher talent beliefs have been observed in the mathematics domain, they have been measured using generalized items instead of domain-specific ones (Heller et al., 2001). However, talent models with potential and performance aspects have focused on domains and subject-specific separations (Gagné, 2005, 2010; Heller et al., 2005), as have talent development models, such as the talent-development-in-achievement-domains framework (TAD) (Preckel et al., 2020). The TAD is based on the talent development mega-model (Subotnik et al., 2011), created through the synthesis of research and practice. The TAD describes talent development in different achievement domains and accounts for domain specificity. In the TAD framework, the early phase of talent development is interdisciplinary, and it is subject-specific in the advanced phase. The primary goal is to promote talent development research across various domains (Preckel et al., 2020). Thus, our study extends Preckel et al.'s (2020) proposed foundation for a domain-specific orientation. "The empirical evidence clearly shows that the process of talent development varies by domain, even though several cross-domain similarities could be identified" (Preckel et al., 2020, p. 713). Neuendorf et al.'s (2023) meta-analysis confirms a more domain-specific approach to talent development using newer talent models.

2.2. Teacher Talent Beliefs Considering Domain Specificity

Research on teacher pedagogical beliefs confirms the domain specificity of certain epistemological beliefs (Korom et al., 2023; Urhahne & Kremer, 2023) (for an overview of empirical studies on domain specificity, see Muis et al., 2006). In the field of implicit theories concerning talent and ability beliefs, scholars have recently attempted to understand whether mindsets should be differentiated by topic. Based on this, the term "field-specific ability beliefs" (FABs) was proposed (Asbury et al., 2023; Gunderson et al., 2017; Heyder et al., 2020; Leslie et al., 2015). The term captures differences, for instance, in the mindsets of teachers who teach mathematics compared with those who teach German. Mathematics teachers have a more fixed mindset (so-called "brilliance beliefs") compared with those teaching German (Heyder et al., 2019). Evidence shows that teachers' FABs are associated with students' motivation and performance in mathematics (Heyder et al., 2019). Asbury et al. (2023) contributed to the disentanglement of fixed mindsets and FABs, stating that they are correlated but distinctly separate constructs. They explored the domain specificity of FABs and investigated the relationship between them and teacher motivation, including enthusiasm, self-concept, and pedagogical interest.

2.3. A Comprehensive Model of Talent Beliefs

Acknowledging the need for a comprehensive model of talent beliefs, a recent study created an analogy for theoretical multidimensional talent development models (Rogl, 2022). The measurement model used in the above referred study for teacher talent beliefs was the first-of-its-kind multidimensional domain-specific model, and the study confirmed five of the six expected dimensions of talent beliefs, some of which predicted cognitively activating teaching (with a 19% variance explained).

Rogl (2022) formulated and deducted the theoretical model of teacher talent beliefs in the domain of mathematics, in which recognized research in terms of teacher beliefs existed, based on the major surveys of the COACTIV (Cognitive Activation in the Classroom: The Orchestration of Learning Opportunities for the Enhancement of Insightful Learning in Mathematics; Baumert & Kunter, 2006) and Teacher Education and Development Study in Mathematics (TEDS-M) models (Blömeke et al., 2011), although these were not related to talent. To generate new concepts of talent beliefs, different approaches in current talent models were considered, including psychometric models (Rost, 2009), multi-component and moderator models (Gagné, 2005; Heller, 2001; Renzulli, 2005), performance-oriented dynamic models (Ericsson et al., 2007; Gruber, 2007), systemic models (Ziegler, 2005), and domain-specific models in mathematics (Fuchs, 2006; Käpnick, 2014). Analysis of these models reveals that each one emphasizes certain aspects of talent development and their respective influences. These models make assumptions about the passions of gifted individuals, the measurability of outcomes and performance, domain-specific abilities, internal influences on talent development, the determination of giftedness, and the external influences on talent development. Rogl (2022) derived the following six dimensions for the theoretical model of talent beliefs based on this common assumption of the models: (1) beliefs about the passion of mathematically gifted students, (2) beliefs about the achievement of mathematically gifted students, (3) beliefs about the domain-specific skills of mathematically gifted students, (4) beliefs about the internal factors of mathematical giftedness, (5) beliefs about the determination of mathematical giftedness, and (6) beliefs about the external factors of mathematical giftedness. Talent beliefs about mathematically gifted students can lead teachers to expect excellent modeling, high abstraction, and intuitive problem-solving skills. The passion and enthusiasm dimension includes beliefs about the emotional and motivational aspects of gifted students and beliefs about the emotional coloring of mathematics. In this case, teachers believe that mathematically talented students enjoy mathematical experimentation and desire complex tasks or creative solutions. Performance-related talent beliefs in the achievement dimension associate mathematical talent with performing well in a mathematics class, being at the top of the class, or having higher number of correctly solved questions. Determination summarizes beliefs about the genetic dependence of talent, innateness, and predisposition. These beliefs reveal whether teachers consider talent as innate or independent of heredity, and whether it is stable or developable. Internal factors include the belief in internal components, such as a strong desire to achieve, high work discipline, strong perseverance, or a formidable ability to concentrate and control talent. Finally, the external factors focus on the beliefs regarding the influence of environmental support, including teachers, parents, and the various challenges and competitions for developing mathematical talent. Five dimensions of the six theoretically derived talent beliefs in mathematics were empirically supported (comparative fit index (CFI) = 0.93; Tucker–Lewis index (TLI) = 0.91; root mean square error of approximation (RMSEA) = 0.06; standardized root mean square residual (SRMR) = 0.07; $\chi^2/df = 1.65$, $\chi^2(109, N = 176) = 179.57$, p ($\chi^2$) = 0.000; Rogl, 2022). Aligned with the current talent models, the five theoretical dimensions—passion, achievement, domain-specific skills, internal factors, and determination—were also identified in the data, providing an adequate representation of teachers' multidimensional talent beliefs. Rogl (2022) emphasizes the need for further operationalization and follow-up research on the external influences on mathematical talent to integrate the latent factor of talent beliefs into the existing five-factor model.

As teacher talent beliefs in mathematics are an important construct, this study has broadened the approach to include the verbally gifted domain (Rogl et al., 2025). The authors considered whether teacher talent beliefs for verbal giftedness could be measured

similarly to talent beliefs for mathematics. This study also established an instrument for assessing teacher verbal talent beliefs based on the theoretical literature about high verbal abilities (Farkas, 2014) and on the mathematics model (Rogl, 2022), which had been validated. The verbal model comprised the same structure as the mathematics talent beliefs model (Rogl, 2022) although with the addition of a sixth factor: external teacher factors. We specified this sixth factor, theoretically derived by Rogl (2022), to capture teacher influence on students' verbal talents (Rogl et al., 2025). We also added this factor to correspondingly capture teacher influence on students' mathematical talents. Adapted for the verbal giftedness domain, the items in the verbal talent beliefs questionnaire were similar to those in the mathematics questionnaire (Rogl et al., 2025). In the structural equation model, student teachers' verbal talent beliefs about determination and internal factors could predict their fixed mindset, while talent beliefs about passion and achievement were able to predict their self-efficacy. The concept of growth versus a fixed mindset and teacher talent beliefs are two different constructs, although they share similarities (Rogl et al., 2025).

3. Methodology

Using the two validated instruments for teacher talent beliefs in the domains of mathematics (Rogl, 2022) and verbal giftedness (Rogl et al., 2025), we investigated whether student teachers' talent beliefs were domain-specific or similar across domains. Specifically, our research question is as follows: do student teachers' talent beliefs regarding verbal and mathematics giftedness differ intra- and inter-individually based on the domain?

3.1. Samples and Procedures

Our study included 215 student teachers from two Austrian universities offering teacher education programs for general secondary education, divided into a bachelor's and a master's program with a minimum duration of 12 semesters overall. Student teachers can choose two subjects in these programs (for an overview of study areas in our sample, see Table 1). In total, 82% were in the first semester of their program; that is, most had just started studying to become a teacher. Similarly to the population of teachers in Austria, most were female (68%, 1% diverse, 28% male, and 3% no specification). Among the participants, 5% had experience of working as a teacher in a school. The mean participant age was 22.01 years (SD = 5.96, Min = 18, Max = 50). Student teachers volunteered to participate, gave their written consent in the online questionnaire, and completed the survey during their regular university courses. They were offered five vouchers of EUR 50 each from a local bookstore in a lottery drawing as an incentive for participation. Data were gathered anonymously. Participants were able to leave their email addresses if they wanted to participate in the lottery draw for the book vouchers on a separate site that could not be connected to their survey data. Participants were adults who volunteered to participate in the survey study, and no ethical issues could be identified before or during the research.

Table 1. Frequencies and percentage of student teachers' study areas.

Study Area	n	%
Mathematics	43	20
German	32	15
Foreign language	61	28
German and a foreign language	6	3

Table 1. *Cont.*

Study Area	n	%
Mathematics and German	2	1
Mathematics and a foreign language	1	0.5
Domains other than mathematics, German, or foreign languages	70	33

3.2. The Questionnaire Survey

The survey was programmed in LimeSurvey Version 6 and comprised a verbal and mathematics talent beliefs questionnaire, as well as demographic data.

3.2.1. Verbal Talent Beliefs

As mentioned above, the verbal talent beliefs survey is based on an existing study (Rogl et al., 2025). It comprised 22 items on six scales: passion included four items (e.g., I am convinced that verbally gifted students read with enthusiasm, $\alpha = 0.742$), achievement included three items (e.g., I am convinced that verbal giftedness is visible through excellence in language lessons, $\alpha = 0.752$), domain-specific skills included five items (e.g., I am convinced that verbally gifted students are characterized by brilliant rhetoric, $\alpha = 0.720$), internal factors included four items (e.g., I am convinced that students' verbal giftedness benefits from a high ability to concentrate, $\alpha = 0.745$), determination included three items (e.g., It is my conviction that verbal giftedness is innate, $\alpha = 0.773$), and external teacher factors included three items (e.g., I am convinced that students' verbal giftedness benefits from my enthusiasm for languages as a teacher, $\alpha = 0.852$). Within the same introduction, the items were presented in a random order (all items are listed in Rogl et al., 2025). The complete list of items can be found via a link to Rogl et al. (2025) in Appendix A.1.

3.2.2. Mathematics Talent Beliefs

The mathematics talent beliefs survey was adapted to match the verbal talent beliefs questionnaire (Rogl, 2022). In its final form, after empirically choosing those items that on the one hand match the verbal talent beliefs items and on the other hand have the best factor loadings, it comprised 19 items on the same six dimensions covered in the verbal talent beliefs segment, using similar introductory sentences, albeit with different wording per the domain (all items are listed in Rogl et al., 2025). The mathematics talent belief model showed adequate model fit ($\chi^2/df = 1.551$; RMSEA = 0.051; SRMR = 0.055; CFI = 0.947; TLI = 0.933), as did the similar one for verbal talent beliefs (Rogl et al., 2025). The scale for passion included three items (e.g., I am convinced that mathematically gifted students are fascinated by numbers, $\alpha = 0.716$), achievement included three items (e.g., It is my conviction that mathematical giftedness is visible through excellence in mathematics lessons, $\alpha = 0.691$), and domain-specific skills included three items (e.g., I am convinced that mathematically gifted students have intuitive problem-solving skills, $\alpha = 0.709$). Internal factors included four items (e.g., I am convinced that students' mathematical giftedness benefits from a high ability to concentrate, $\alpha = 0.864$), determination included three items (e.g., It is my conviction that mathematical giftedness is innate, $\alpha = 0.920$), and external teacher factors included three items (e.g., I am convinced that students' mathematical giftedness benefits from my enthusiasm for mathematics as a teacher, $\alpha = 0.770$). Within the same introduction, the items were presented in a random order, similar to the verbal talent beliefs questions. The complete list of items can be found in Appendix A.2.

3.3. Analytic Procedures

We used paired-sample *t*-tests in IBM SPSS Statistics Version 29.0.0.0 to compare verbal and mathematics talent beliefs among participants. For the analysis between participants, we first aimed to understand whether there was a difference in verbal talent beliefs between student teachers majoring in German and those majoring in other languages. As there were no significant differences, we merged these students into one language group specializing in the verbal domain. To compare the mathematics and verbal talent beliefs between student teachers who specialized in either domain, we used *t*-tests for independent samples.

4. Results

4.1. Domain-Specific Differences Among the Student Teachers

A G-Power calculation was performed using G*Power version 3.1.9.4 in preparation to estimate the optimal sample size. For the paired sample *t*-test to detect domain-specific differences among the student teachers, a total sample size of 202 participants (compared to our sample size of N = 215 student teachers) would have been optimal to detect small effects (d = 0.3) with an alpha error probability of $\alpha = 0.01$ and a power of 0.95 in a two-tailed comparison.

Among the participants, *t*-tests for paired samples showed statistically significant differences in the means of the verbal and mathematics talent beliefs for five of the six talent belief dimensions: passion, achievement, internal factors, determination, and external teacher factors. Table 2 presents the descriptive statistics for all six dimensions of student teachers' talent beliefs in both domains and the results of the paired-sample *t*-tests and effect sizes. Mean values show the level of agreement on a slider from 1 to 100 for each dimension of the talent beliefs in both domains. Higher values indicate higher agreement. The *p*-values indicate statistically significant differences between the mathematics and verbal domains.

Table 2. Descriptive statistics and paired-sample *t*-tests for verbal and mathematics talent beliefs.

***N* = 215**		***M***	***SD***	***t***	***df***	$p_{\text{two-tailed}}$	**Cohen's *d***
Passion	Mathematics	73.158	15.463	11.978	214	<0.001	0.817
	Verbal	57.813	15.410				
Achievement	Mathematics	56.961	18.873	−5.122	214	<0.001	−0.349
	Verbal	62.358	16.506				
Domain-specific skills	Mathematics	69.736	14.561	−0.139	214	0.890	−0.009
	Verbal	69.864	12.816				
Internal factors	Mathematics	74.306	15.335	9.167	214	<0.001	0.625
	Verbal	66.785	15.458				
Determination	Mathematics	41.966	25.519	−2.011	214	0.046	−0.137
	Verbal	44.130	20.274				
External teacher factors	Mathematics	80.732	14.318	6.495	214	<0.001	0.443
	Verbal	75.478	16.586				

Note. >0.2 small effect, >0.5 medium effect, >0.8 large effect.

Across domains, as can be observed in Table 2, the participating student teachers agreed that talent could be observed in student passion, achievement, and domain-specific skills. They also agreed that internal factors, as well as their own behavior as teachers, impacted students' talent development. However, they did not agree that talent was predetermined.

Regarding domain-specific, intra-individual differences, student teachers agreed to a higher extent that talent can be readily observed in a student's passion in the mathematics domain than in the verbal domain. This difference was indicated by a large effect. However, for the achievement dimension, the results indicated the opposite. Student teachers agreed more that talent can be observed in students' academic achievement in the verbal domain than in the mathematics domain. However, the effect size was small. The level of student teacher agreement regarding talent being displayed in students' domain-specific skills, such as problem solving for mathematics or rhetoric in the verbal domain, did not differ in a statistically significant way. For internal factors, student teachers' agreement was higher in mathematics, with a medium effect size; that is, student teachers were in greater agreement with the theory that talent was dependent on internal factors in the mathematics domain, like the ability to concentrate, rather than in the verbal domain. With a very small, but statistically significant effect, student teachers also agreed that talent was more predetermined in the verbal domain than in the mathematics domain. Concerning external teacher factors, the effect size was small. Student teachers agreed more that their own behavior influenced students' talent in mathematics than in the verbal domain.

4.2. Domain-Specific Differences Between Student Teachers Specializing in Different Domains

Table 1 shows the number and percentage of student teachers in our sample in different study areas. Most students were studying a foreign language or mathematics, followed by students who were studying German or a combination of those study areas. We excluded 33% participants who were studying other domains that were not relevant to our research question from the analysis.

As statistically significant differences were not found between students who were studying German and those studying another foreign language on the verbal talent beliefs dimensions, we merged these into one group in the verbal domain (n = 99).

Self-reported gender distribution (i.e., participants self-identifying as female, male, or gender-diverse) was similar for student teachers specializing in the verbal domain, that is, German and foreign languages (75% female, 24% male, 1% diverse), and in mathematics (74% female, 23% male, 2% missing). The Mann–Whitney U test did not show statistically significant differences in the gender distribution between the two domains ($z = -0.211$, $p = 0.833$).

For the *t*-tests for independent samples, to test for differences between student teachers who specialized in different domains, the optimal sample size calculated with G*Power for the two groups specializing in different domains to detect a medium effect ($d = 0.5$; $\alpha = 0.05$; $1 - \beta = 0.95$) would be 105. For the verbal domain, our sample of student teachers nearly reaches this number with n = 99; for mathematics, the sample size (n = 43) is smaller.

Between student teachers who specialized in different domains, *t*-tests for independent samples did not show differences in verbal talent beliefs on all dimensions, although for achievement and external teacher factors, significance barely failed. For mathematics talent beliefs, however, there were statistically significant differences between student teachers specializing in mathematics and those specializing in the verbal domain on all talent belief dimensions, except for external teacher factors. Table 3 shows the descriptive statistics and results of the independent sample *t*-tests. Mean values indicate the level of agreement for each dimension of talent beliefs in both domains, according to student teachers' specializations.

Table 3. Descriptive statistics and independent sample *t*-tests for verbal and mathematics talent beliefs according to student teachers' specializations.

Talent Beliefs in Domain...	Dimension	Teacher Education Specialization	*M*	*SD*	*t*	*df*	$p_{\text{two-tailed}}$	Cohen's *d*
Verbal	Passion	Mathematics	57.733	15.1837	−0.035	140	0.972	−0.006
		Verbal	57.384	17.077				
	Achievement	Mathematics	66.527	14.613	1.847	140	0.067	0.337
		Verbal	60.653	18.479				
	Domain-specific skills	Mathematics	72.805	10.584	1.709	140	0.090	0.312
		Verbal	68.893	13.280				
	Internal factors	Mathematics	66.192	16.120	−0.487	140	0.627	−0.089
		Verbal	67.518	14.344				
	Determination	Mathematics	49.109	16.766	1.257	140	0.211	0.230
		Verbal	44.303	22.488				
	External teacher factors	Mathematics	71.690	17.744	−1.776	140	0.078	−0.324
		Verbal	77.162	16.481				
Mathematics	Passion	Mathematics	77.349	14.655	3.154	140	0.002	0.576
		Verbal	68.397	15.904				
	Achievement	Mathematics	61.419	15.770	2.582	140	0.011	0.472
		Verbal	52.737	19.430				
	Domain-specific skills	Mathematics	73.969	12.914	2.392	140	0.018	0.437
		Verbal	67.741	14.793				
	Internal factors	Mathematics	78.314	13.766	2.143	140	0.034	0.391
		Verbal	72.540	15.155				
	Determination	Mathematics	49.078	23.937	2.126	140	0.035	0.388
		Verbal	39.128	26.319				
	External teacher factors	Mathematics	80.853	14.131	0.110	140	0.913	0.020
		Verbal	80.556	15.057				

Note. Specialization: mathematics n = 43; verbal n = 99; >0.2 small effect, >0.5 medium effect, >0.8 large effect (Cohen, 1988).

Student teachers specializing in mathematics agreed more that mathematically talented students revealed a passion for mathematics (M = 77.349) than did student teachers specializing in the verbal domain (M = 68.397). The difference was of a medium effect size. Math specialists also agreed more that mathematically talented students have high academic achievement in mathematics (M = 61.419) than language specialists did (M = 52.737; small effect size). Math specialists were also in greater agreement that mathematically talented students show high domain-specific skills relevant to mathematics (M = 73.969) than did language specialists (M = 67.741; small effect). Additionally, student teachers specializing in mathematics agreed more that mathematical talent depends on internal factors (M = 78.314) than did student teachers specializing in the verbal domain (M = 72.540; small effect), and they assessed mathematical talent to be more predetermined (M = 49.078) than did student teachers specializing in the verbal domain (M = 39.128; small effect). Concerning the influence of teacher behavior on mathematical talent, student teachers specializing in mathematics assessed it as equally high (M = 80.853) as student teachers specializing in the verbal domain (M = 80.556).

5. Discussion

After reviewing the literature (Rogl et al., 2025; Rogl, 2022), we realized that a more in-depth investigation is required to achieve a deeper understanding of the domain specificity in teacher talent beliefs. In sum, we addressed the central research question as to whether teacher talent beliefs are domain-specific or similar across two different domains. This study allows us to understand if student teachers have different talent beliefs in the domains of verbal and mathematical giftedness. In addition, we examined if talent beliefs differed between individuals, particularly between those who specialize in one or other of the domains during their teacher education.

With regard to domain-specific talent development models such as the TAD framework (Preckel et al., 2020) or others that come from didactics in the academic field of mathematics (Fuchs, 2006; Käpnick, 2014) this could be a supplement and proof of how important the domain-specific approach is.

5.1. Domain-Specific Differences Between Student Teachers

Intra-individually, we found differences in student teachers' mathematical and verbal talent beliefs on five of the six talent belief dimensions. This result is consistent with the results of other talent models highlighting potential domains (Gagné, 2005, 2010; Heller et al., 2005), research results on the domain specificity of epistemological beliefs (Korom et al., 2023; Urhahne & Kremer, 2023), and results on field-specific ability beliefs (Asbury et al., 2023; Gunderson et al., 2017; Heyder et al., 2020; Leslie et al., 2015).

In our study, student teachers recorded significantly higher values on the passion scale for mathematics talent beliefs than for verbal talent beliefs, indicating that student teachers believe that students' mathematics talent was more dependent on their passion for mathematics versus students' verbal talent was on their passion for language. Furthermore, in the verbal domain, student teachers believed that talent was more strongly reflected in student verbal achievement than mathematics talent in mathematics achievement. Concerning internal factors, student teachers believed that student talent was more heavily dependent on internal factors, such as strong endurance, a high ability to concentrate, or a high level of work discipline in mathematics than in the verbal domain. In terms of determination, the difference between the domains was smaller than that in the other dimensions, although it was statistically significant. The participants believed that in both domains, student talent was not predetermined but could be developed; however, beliefs about determination were higher in the verbal domain. This result contrasts with that of Heyder et al. (2019), who found that mathematics teachers showed more of a fixed mindset than German language teachers did. Again, in both domains, student teachers believed that they, as external factors, could develop students' talents. However, they believed that this could have a greater impact in the domain of mathematics than in the verbal domain. Notably, but not necessarily surprisingly, the only dimension in which we did not find a statistically significant intra-individual difference was for domain-specific skills. In both domains, student teachers agreed that talent is apparent in students' domain-specific skills. Upon examining the questionnaire items for both domains on the dimension, we found that the items for verbal and mathematics talent beliefs showed greater content differences than those for other dimensions. For example, for the determination dimension, item formulation was the same for the verbal and mathematics domains, despite the introduction; for the domain-specific skills dimension, the content focused on specific skills in each domain—for example, demonstrating brilliant rhetorical skills, having a large vocabulary, or describing more complex issues in a nuanced way in the verbal domain and a higher capacity for abstraction, as well as intuitive problem-solving skills, in the mathematics domain. Thus, domain specificity is depicted in the items for this dimension, in contrast to the other

dimensions. We assumed that if we presented the same item formulation, for example, showing brilliant rhetorical skills for both domains, we would also find intra-individual differences in domain-specific skills.

We also found a pattern that suggested that student teachers' mathematics talent beliefs aligned more with a modern multivariate understanding of talent, as shown in the current talent development models (Preckel et al., 2020; Subotnik et al., 2021). Factors such as passion and internal factors such as volition or ability to concentrate, which are also crucial in these models, are believed to be more relevant in mathematics, whereas in the verbal domain, achievement and determination, which represent a monocausal understanding of talent as a one-dimensional construct (Sternberg & Kaufman, 2018), is regarded as more significant than it is in mathematics. Our findings imply the need to address a broader understanding of talent, as in modern talent development models, in teacher education. Further, in the verbal domain, education that emphasizes the relevance of passion, motivation, interest, and volition would be effective alongside the potential for developing verbal talent.

5.2. Domain-Specific Differences Between Student Teachers Specializing in Different Domains: Mathematics Versus Verbal Talent Beliefs

Inter-individually, we only found statistically significant differences in mathematical talent beliefs, indicating that students who specialized in mathematics had different talent beliefs on all dimensions than students who specialized in the verbal domain, despite the external teacher influence.

Among mathematics students, there was greater agreement on the mathematical talent belief items than among language students. Mathematics students believed more than language students that mathematical talent is reflected and conditioned by passion, achievement, domain-specific mathematical skills, internal factors, and determination.

This pattern was not observed for verbal talent beliefs. Regardless of whether the participants were majoring in languages or mathematics, they had similar talent beliefs across dimensions. The underlying reasons for this may relate to differences in student teachers' motives for choosing a major, specifically in their assessment of their talent in that area, or in understanding talent in a specific domain that is present in society (Hartmann et al., 2022; Kaub et al., 2012; Roloff Henoch et al., 2015). One possibility is that students chose to pursue a career as mathematics teachers because they believed in their own talent in mathematics (Kuendiger et al., 1997), whereas student teachers in languages might not have considered their verbal talent special (Watt et al., 2017). Thus, mathematics student teachers could have clarity on what constitutes mathematical talent because of their own experiences. Regarding verbal talent, no clear picture seems to exist, as the verbal belief mean values for student teachers in both domains were lower than those for the mathematical talent beliefs of mathematics student teachers.

5.3. Limitations and Future Research

First of all, it should be noted that this study relied on a convenience sample, which is a limitation. Several other limitations and implications should be addressed and investigated in future studies (Rogl et al., 2025). One issue worthy of further investigation is the possible differences in talent beliefs between student teachers and practicing teachers, especially as student teachers in this study were in the beginning of their studies. Thus, student teachers' experiences arose mainly from their time at school. Future studies could examine practicing teachers' talent beliefs considering specific domains. However, with some studies finding significant differences in the theory of intelligence (TOI) and others finding no major difference (Patterson et al., 2016), there are no definite results in the literature on the TOI regarding differences between student teachers and practicing teachers. Follow-up

studies could subsequently also clarify the aspect of how belief systems of (future) teachers could be changed in the course of their professional training.

In the inter-individual examination, mathematics student teachers were compared with language student teachers. However, mathematics student teachers or language student teachers were not compared with student teachers in other domains. This approach was preferred because these two domains were expected to present sufficient contrast. When we calculated the inter-individual differences in mathematical talent beliefs between mathematics (n = 43) and non-mathematics (n = 169) student teachers and in verbal talent beliefs between student teachers in languages (n = 99) and other domains (n = 113), we found the same pattern. Statistically significant differences were observed in mathematical talent beliefs, at least in the one-tailed test between mathematics and non-mathematics student teachers across all dimensions, despite the external factor. No statistically significant differences were observed in verbal talent beliefs between student teachers in languages and those in other domains.

Concerning the sample sizes for the interindividual comparison of student teachers who specialized in different domains, another limitation is that the group of student teachers specializing in mathematics did not meet the optimal sample size, whilst the group of student teachers specializing in the verbal domain did. One could assume that we would not be able to detect effects that could exist, because of the smaller sample size in this one subsample. However, we did find statistically significant differences for mathematical talent beliefs between students specializing in the different domains with small-to-medium effects (see Table 3).

Questionnaires for assessing talent beliefs in other domains, such as STEM (Science, Technology, Engineering, Mathematics) or music, can be developed to test domain specifics. Future studies could also address the motives for choosing a specific career domain and self-assessment of one's talent as the possible predictors of talent beliefs. Furthermore, societal understanding of talent across various domains and its impact on talent beliefs could be explored.

No study has yet tested the predictive power of verbal talent beliefs for teaching quality, as has been tested for mathematics talent beliefs, which predicted cognitively activating teaching, with an explained variance of 19% (Rogl, 2022). Future studies could consider including teaching quality and its connection with verbal talent beliefs to highlight their relevance in effective teaching. Furthermore, studies could examine which dimensions are particularly important.

5.4. Implications and Conclusions

This study contributes to the literature on beliefs about giftedness and talent by examining them in depth and considering possible domain-specific aspects. If student teachers and practicing teachers hold different beliefs across various domains, these issues can be addressed in a more differentiated manner within the context of teacher education and training.

We found that talent beliefs are domain-specific, at least among individuals. Domain specificity for mathematical talent beliefs was also true in our comparison of the study participants. A multidimensional assessment of talent beliefs seems necessary to address talent as a complex construct, as described in the modern talent development models (Preckel et al., 2020; Subotnik et al., 2021). Based on their multidimensional nature, talent beliefs differ from FABs (Heyder et al., 2019), which mainly focus on the determination dimension. The complexity and domain specificity of talent beliefs can be addressed not only in teacher training but also in teacher education curricula, as they can impact teaching quality (Rogl, 2022). In fact, domain-specific talent beliefs can be thematized in terms of

pedagogical knowledge in educational sciences, in subject didactics, and in practical ways for planning and reflecting the phases of teaching practice. Although deep-seated beliefs are difficult to change, there is evidence that they can be changed through instruction and training (Blackwell et al., 2007; Patterson et al., 2016).

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Appendix A

Appendix A.1

Link to the questionnaire about Verbal Talent Beliefs published in Rogl et al. (2025), https://www.frontiersin.org/articles/10.3389/feduc.2025.1513424/full#supplementary-material (accessed on 14 July 2025).

Appendix A.2

Questionnaire on Mathematics Talent Beliefs

The original questionnaire on mathematics talent beliefs has only been tested in German. The items are based on Rogl (2022).

Leidenschaft [passion] ($\alpha = 0.716$)

*Ich bin überzeugt, dass mathematisch begabte Schüler*innen . . . [I am convinced that mathematically gifted students . . .]*

MP1: . . . eine Faszination für Zahlen zeigen. [. . . are fascinated by numbers.]

MP2: . . . Freude am Tüfteln haben. [. . . enjoy tinkering.]

MP3: . . . Lust an komplexen Aufgaben zeigen. [. . . show a passion for complex tasks.]

Leistung [achievement] ($\alpha = 0.691$)

*Ich bin überzeugt, dass mathematisch begabte Schüler*innen . . . [I am convinced that mathematically gifted students . . .]*

MA1: . . . eine Spitzenposition in der Klasse belegen. [. . . occupy a top position in the class.]

Meiner Überzeugung nach ist mathematische Begabung . . . [It is my conviction that mathematical giftedness is . . .]

MA2: . . . durch Spitzenleistungen im Mathematikunterricht sichtbar. [. . . visible through excellence in mathematics lessons.]

MA3: . . . durch die Anzahl richtig gelöster Aufgaben feststellbar. [. . . measurable by the number of correctly solved tasks.]

Domänenspezifische Fähigkeiten [domain-specific skills] ($\alpha = 0.709$)

*Ich bin überzeugt, dass mathematisch begabte Schüler*innen . . . [I am convinced that mathematically gifted students . . .]*

MDS1: . . . ein hohes Abstraktionsvermögen besitzen. [. . . possess a high capacity for abstraction.]
MDS2: . . . intuitive Problemlösefähigkeiten besitzen. [. . . have intuitive problem-solving skills.]
MDS3: . . . hohe Modellierungsfähigkeiten zeigen. [. . . demonstrate high modeling skills.]

Internale Faktoren [internal factors] (α = 0.864)

*Ich bin überzeugt, dass die mathematische Begabung der Schüler*innen begünstigt wird durch . . . [I am convinced that students' mathematical giftedness benefits from . . .]*
MI1: . . . ein starkes Durchhaltevermögen. [. . . a strong perseverance.]
MI2: . . . einen starken Leistungswillen. [. . . a strong will to perform.]
MI3: . . . eine hohe Konzentrationsfähigkeit. [. . . a high ability to concentrate.]
MI4: . . . eine hohe Arbeitsdisziplin. [. . . a high work discipline.]

Determiniertheit [determination] (α = 0.920)

Meiner Überzeugung nach ist mathematische Begabung . . . [It is my conviction that mathematical giftedness is . . .]
MD1: . . . vorbestimmt. [. . . predetermined.]
MD2: . . . genetisch bedingt. [. . . genetically determined.]
MD3: . . . angeboren. [. . . innate.]

Externale Faktoren–Lehrer*in [external teacher factors] (α = 0.770)

*Ich bin überzeugt, dass die mathematische Begabung der Schüler*innen begünstigt wird durch . . . [I am convinced that students' mathematical giftedness benefits from . . .]*
ME1: . . . die Art, wie ich als Lehrer*in meinen Unterricht gestalte. [. . . the way I organize my lessons as a teacher.]
ME2: . . . meine Fachkompetenz als Lehrer*in. [. . . my expertise as a teacher.]
ME3: . . . meine Mathematikbegeisterung als Lehrer*in. [. . . my enthusiasm for mathematics as a teacher.]

Appendix B

Tables with model fit indices for both questionnaires (Tables A1 and A2).

Table A1. Model fit (verbal talent beliefs).

χ^2/df	RMSEA	SRMR	CFI	TLI
1.332	0.039	0.059	0.943	0.932

Table A2. Model fit (mathematics talent beliefs).

χ^2/df	RMSEA	SRMR	CFI	TLI
1.551	0.051	0.055	0.947	0.933

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