Impact of Different Levels of Epistemic Beliefs on Learning Processes and Outcomes in Vocational Education and Training

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Abstract

Epistemic beliefs are individuals' beliefs about knowledge and knowing. Modelling them is currently based on two central assumptions. First, epistemic beliefs are conceptualized as a multi-level construct, i.e. they exist on a general, academic, domain-specific and/or topic-specific level. Second, research assumes that their more concrete levels predict learning processes and outcomes more strongly than their more general levels. However, studies directly investigating these assumptions are still missing. 975 prospective retailers, wholesalers, bank assistants, and industrial assistants reported their grades and learning motivation in accounting and marketing as well as their epistemic beliefs in an effort to prove both assumptions within the context of Vocational Education and Training. Second-order confirmatory factor analysis confirms the multi-level conceptualization of epistemic beliefs. The findings here indicate a superiority of domain- and topic-specific epistemic beliefs compared to general epistemic beliefs for predicting motivation and achievement in marketing and accounting. The study concludes that domain- and topic-specific epistemic beliefs explain different facets of learning phenomena. In addition, further research should concentrate more on both the domain- and topic-specific levels.

Keywords: *epistemic beliefs; motivation; achievement; general; domain-specific; topic-specific*

1. Introduction

Individuals' beliefs about knowledge and knowing are called *epistemic beliefs* (Hofer & Pintrich, 1997). They function as a lens through which a person interprets materials and learning demands, and influence learning and instruction processes (Rebmann, Schloemer, Berding, Luttenberger, & Paechter, 2015). A variety of studies report their impacts on motivation, achievement, text comprehension, learning strategies, teaching conceptions, and additional constructs (e.g., Bråten, Strømsø, & Samuelstuen, 2008; Cano, 2005; Deng, Chai, Tsai, & Lee 2014; Mason, Boscolo, Tornatora, & Ronconi, 2013; Paechter et al., 2013; Ricco, Schuyten Pierce, & Medinilla, 2010; Saeed, Reza, & Momene, 2014). These findings emphasize the relevance of epistemic beliefs for understanding learning phenomena.

Modelling epistemic beliefs has clearly changed in the past decades. Researchers initially assumed only general beliefs describing individuals' ideas about knowledge and knowing across contexts, situations, domains, and topics (e.g., Schommer, 1990; Schommer-Aikins, Duell, & Barker, 2003). Current research on the other hand postulates a multi-level conception (e.g., Greene & Yu, 2014). For example, Buehl and Alexander (2006) differentiate between general and domain-specific epistemic beliefs while Muis, Bendixen, and Haerle (2006) postulate three levels of general, academic-, and domain-specific beliefs. Bråten et al. (2008) built on Muis et al.'s (2006) model to add a fourth level of topic-specific beliefs within a domain.

The introduction of these new levels is accompanied by assumptions about their relevance for learning and instruction processes. Domain-specific beliefs are expected to have a stronger impact on learning processes and outcomes than general epistemic beliefs (e.g., Buehl & Alexander, 2006; Muis et al., 2006). The idea behind this hypothesis is that domain-specific beliefs develop through interaction with domain-specific knowledge and problems. In other words, they describe the corresponding phenomena of a domain in greater detail than general beliefs. Bråten

et al. (2008) argue that topic-specific epistemic beliefs explain learning phenomena better than domain-specific epistemic beliefs because they are more closely connected to concrete content knowledge and its corresponding learning activities. The central line of argumentation here is that more specificity leads to better and/or increased explanatory power.

Only a few studies however consider multiple levels in their research design. For example, Schommer-Aikins and Duell (2013) found that general learning beliefs influence mathematical performance via domain-specific epistemic beliefs. Mokwinski (2011) analyzed general and domain-specific epistemic beliefs within Vocational Education and Training (VET) but did not compare the explanatory power of these levels. And the fact is, most studies concentrate only on one level when investigating the impact of epistemic beliefs on learning (e.g., Bråten et al., 2008; Cano, 2005; Mason et al., 2013; Paechter et al., 2013). To date, they have not really provided any information on the relevance of different levels for understanding learning processes and outcomes.

Furthermore, as a result of concentrating only on one level of epistemic beliefs at a time, studies provide only limited information on the structure of epistemic beliefs across levels. For example, some studies investigate whether individuals from different fields of study differ in their epistemic beliefs (between-subject design) (e.g., Barnard, 2007; Jehng, Johnson, & Anderson, 1993; Paulsen & Wells, 1998). Other studies analyze whether individuals have different epistemic beliefs for specific fields of study (within-subject design) (e.g., Buehl, Alexander, & Murphy, 2002; Schommer-Akins et al., 2003). Because they do not explicitly address different levels, these kinds of studies provide hardly any insights into the different levels of epistemic beliefs *within* an individual. This means that the postulated differentiation of epistemic beliefs and their contributions towards understanding learning phenomena remain unclear. With this in mind, the current paper investigates the plausibility of different levels of epistemic beliefs and their relevance for predicting learning processes and outcomes. The following section elaborates on this issue.

2. Theoretical Background

2.1 Modelling Epistemic Beliefs in Academic Contexts

The past decades of research have developed several models for describing epistemic beliefs (e.g., Chan, 2006; Chinn, Buckland, & Samarapungavan, 2011; Greene, Azevedo, & Torney-Purta, 2008; Hofer & Pintrich, 1997; King & Kitchener 1994; Schommer, 1990). In particular, Muis et al. (2006) and Buehl and Alexander (2006) developed models that focus explicitly on different levels of epistemic beliefs and how these levels operate together.

In Buehl and Alexander's (2006) framework, epistemic beliefs can be differentiated into a general and domain-specific level. Domain-specific beliefs develop from general beliefs when students gain experience in academic domains. When this occurs, they become even more important in domain-specific situations than general beliefs. Both levels interact with each other, supporting or undermining a specific perspective on knowledge and knowing. Within this framework, Buehl and Alexander (2006) assume two different types of beliefs. First, they postulate beliefs that exist on both the general and the domain-specific level (e.g., about the source of knowledge). Second, they assume beliefs which are only relevant within a specific domain. This means that their model does not comprise a purely hierarchical framework.

Similar to Buehl and Alexander (2006), Muis et al. (2008) differentiate a general, academic, and domain-specific level. They "define general epistemic beliefs as beliefs about knowledge and knowing that develop in nonacademic contexts such as the home environment, in interactions with peers, in work-related environments, and any other nonacademic environments" (Muis et al., 2006, p. 33). "Academic beliefs are beliefs about knowledge and knowing that begin to develop once individuals enter an educational system" (Muis et al., 2006, p. 35) and they "define domain-specific epistemic beliefs as beliefs about knowledge and knowing that can be articulated in reference to any domain to which students have been exposed" (Muis et al., 2006, p. 36). In line with Buehl and Alexander (2006), Muis et al. (2006) assume that the more concrete levels of epistemic beliefs develop from the more general levels, and become in turn more important for dealing with domain-specific issues. However, in contrast to Buehl and Alexander (2006) they do not assume that some beliefs are only relevant within a specific domain.

Bråten et al. (2008) extend Muis et al.'s (2006) model by introducing a fourth level of topic-specific beliefs. "In essence, the issue of topic-specificity concerns whether the beliefs one has about knowledge and knowing vary with topics within domains" (Bråten et al., 2008, p. 819). They argue that topic-specific epistemic beliefs have more explanatory power for learning processes and outcomes as domain-specific beliefs because they refer to the concrete content knowledge and the corresponding learning activities.

2.2 Modelling Epistemic Beliefs in the Context of Vocational Education and Training

These models cannot be directly used to investigate epistemic beliefs in the context of VET because they assign vocational situations to the general level and intermingle vocational situations with a downright huge number of other contexts (Muis et al., 2006). Based on international research, Berding (2015; 2016a) provides a working model for describing epistemic beliefs in the context of VET. Figure 1 gives a brief overview.

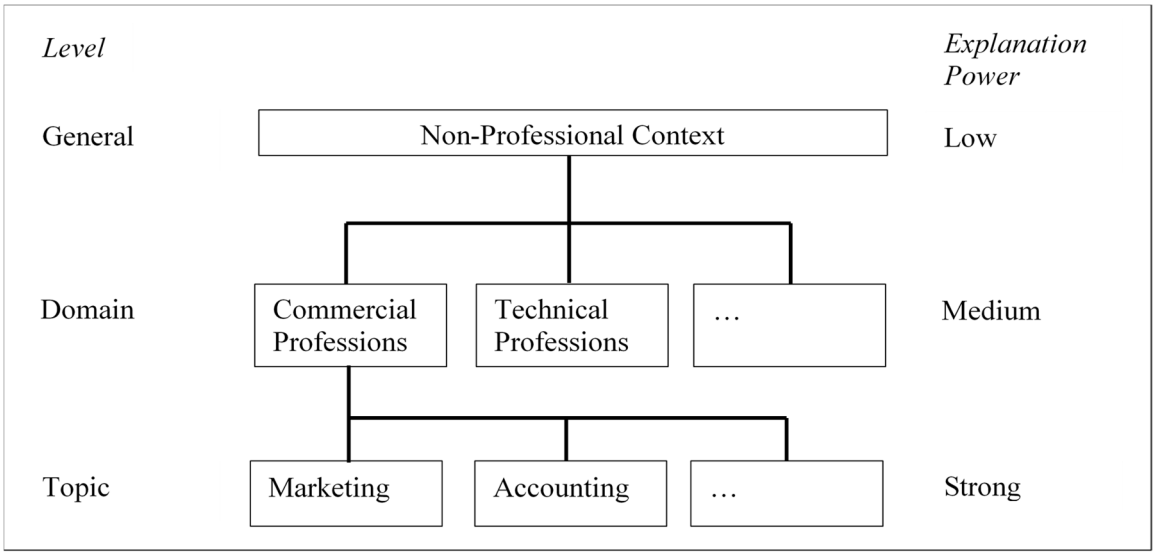

Figure 1. Working Model of Epistemic Beliefs in VET

Dimensions of epistemic beliefs: The model differentiates five dimensions of epistemic beliefs based on the work by Hofer and Pintrich (1997), Müller (2009), and Zinn (2013). The work by Hofer and Pintrich (1997) was chosen as a platform because empirical studies prove the multi-dimensionality of epistemic beliefs, and the identified factors in different studies reflect the postulated epistemic belief dimensions (e.g., Buehl, 2008; Hofer, 2000; Paechter et al., 2013). Furthermore, Hofer and Pintrich's (1997) model is a basis for other work on epistemic beliefs, and is limited to beliefs that many researchers accept and regard as central components of epistemic and epistemological questions (e.g., Bråten, Britt, Strømsø, & Rouet, 2011; Muis et al., 2006). Supplemented by studies on the dimensions of epistemic beliefs in commercial (Müller, 2009) and technical VET (Zinn, 2013), the model outlines epistemic beliefs as follows:

- *Structure of knowledge*: Beliefs about the structure of knowledge range from 'knowledge consists of isolated elements' (absolute view) to 'knowledge is constituted by highly interrelated concepts' (sophisticated view) (Hofer & Pintrich, 1997).
- *Certainty of knowledge*: Beliefs about the certainty of knowledge range from 'knowledge is certain and unchanging' (absolute view) to 'knowledge is uncertain und continuously evolving' (sophisticated view) (Hofer & Pintrich, 1997).
- *Source of knowledge*: Beliefs about the source of knowledge range from 'knowledge exists outside the individual' (absolute view) to 'knowledge is individually constructed inside a person' (sophisticated view) (Hofer & Pintrich, 1997).
- *Justification of knowledge*: Beliefs about the justification of knowledge describe the conditions that need to be fulfilled in order to regard a notion as knowledge. Based on the model by King and Kitchener (1994), this continuum ranges from 'justification by direct observation and authorities' (absolute view) to 'justification by "what feels right"' (absolute view) all the way to 'justification by integrating and balancing arguments, evidence, authorities, and expertise' (sophisticated view) (Hofer, 2004).
- *Applicability of knowledge*: This dimension ranges from 'knowledge is unimportant for managing professional situations' (absolute view) to 'knowledge is a necessary condition for complying with professional requirements' (sophisticated view) (Zinn, 2013).

Levels of epistemic beliefs: In the past, research modelled epistemic beliefs as general beliefs (e.g., Schommer, 1990).

Empirical studies however report evidence that individuals hold different beliefs for different domains (e.g., Buehl et al., 2002; Hofer, 2000; Jehng et al., 1993), and models for describing epistemic beliefs in academic contexts differentiate at least between general and domain-specific beliefs (e.g., Buehl & Alexander, 2006; Muis et al., 2006). Bråten et al. (2008) add a more detailed level within a domain representing individuals' beliefs about concrete topics. This supplement is reasonable since Trautwein, Lüdtke, and Beyer (2004) report a massive variation of 79% on the level of specific topics, whereas only 21% of the variance occurs at the level of personal differences (general epistemic beliefs).

As a consequence, the model distinguishes between *general epistemic beliefs* representing the beliefs about knowledge and knowing in non-professional contexts, and *domain-specific epistemic beliefs* modelling the beliefs about knowledge and knowing in professional contexts. At the domain level these contexts are structured into groups of professions. For example, the model postulates the existence of a commercial context because the analysis of the curricula of 55 commercial professions by the German Federal Institute for Vocational Education and Training (BIBB) indicates that these professions share about 69% of the same knowledge (Brötz et al., 2014). These strong similarities therefore justify the grouping of the 55 professions into a commercial context. Further contexts can be built by creating groups for technical professions (e.g., construction draughtsman) or by forming groups for social professions (e.g., geriatric nurse).

The professional contexts are made more specific by introducing generic topics for the professions. According to the German Federal Institute for Vocational Education and Training (BIBB), the two most important topics here in the commercial context are accounting and marketing, respectively representing 22% and 21% of the professions' shared knowledge (Brötz et al., 2014). These topics form the starting point for the *topic-specific epistemic beliefs*.

Impact on learning: Research emphasizes the role of epistemic beliefs for learning processes and outcomes. For example, Paulsen and Feldman (1999) found that students believing in complex knowledge show a stronger intrinsic goal orientation, a weaker extrinsic goal orientation, and a weaker test anxiety than students believing in simple knowledge. Mokwinski (2011) reports that students believing in complex knowledge on a general level show less intrinsic motivation and interest than students believing in simple knowledge. In contrast, the less students believe in authorities transmitting knowledge, the more interest they show. For apprentices in the field of technical VET, believing in authorities transmitting knowledge is associated with a greater extrinsic motivation on the domain-specific level. The study by Ricco et al. (2010) shows that beliefs about the certainty, the developmental character of knowledge, the reliance on authorities, and the belief in the need for justification are associated with task value, self-efficacy, mastery, and performance goals. Thus, epistemic beliefs influence learners' motivation.

Furthermore, several studies report an impact of epistemic beliefs on learning outcomes. For example, Cano (2005) reports that beliefs about the structure and certainty of knowledge predict academic achievements. The analysis by Mason et al. (2013) shows that beliefs about the certainty and justification of knowledge influence scientific achievements. Ricco et al. (2010) found among other things that beliefs about the certainty of knowledge predict science grades over and above motivational constructs.

In line with Muis et al. (2006), Bråten et al. (2008), and Buehl and Alexander (2006), the model assumes that the more concrete levels of epistemic beliefs predict instruction, learning processes, and success more strongly than the general level. The reason for this is that the domain- and topic-specific beliefs refer more strongly to the concrete content knowledge to be learned and the corresponding learning activities.

3. Research Hypotheses

Against this background, the study addresses the following hypotheses:

(H1) Epistemic beliefs can be differentiated into the three levels of general, domain-specific, and topic-specific beliefs.

(H2) Domain-specific epistemic beliefs predict learning processes and outcomes more strongly than general epistemic beliefs.

(H3) Topic-specific epistemic beliefs predict learning processes and outcomes more strongly than domain-specific epistemic beliefs.

The next section outlines the method used to prove the research hypothesis.

4. Method

4.1 Sample

975 apprentices participated in the study. The 469 women and 506 men were on average 22.07 years old ($SD = 3.846$; $Mdn = 21$). They were either prospective industrial business management assistants ($n_1 = 260$), retailers ($n_2 = 295$), wholesalers ($n_3 = 236$) or bank management assistants ($n_4 = 184$). In Germany, apprentices in these professions are required to pass a three-year apprenticeship combining in-company and school-based training. About 446 were in the second, and 524 in the third year of training (five missing cases).

4.2 Measures

General epistemic beliefs: The Oldenburg Epistemic Beliefs Questionnaire (OLEQ) by Paechter et al. (2013) is used to assess the participants' general epistemic beliefs. The OLEQ represents a continuation of the Schommer Epistemological Questionnaire (SEQ) and the Epistemic Beliefs Inventory (EBI) for German speaking samples. Individuals rate their agreement on a five-point scale ranging from "1 = *I do not agree*" to "5 = *I agree*" (e.g., "Most things in textbooks are trustworthy"). Based on Schommer's (1990) model, this questionnaire measures beliefs about the structure and source of knowledge as well as beliefs about the control of learning processes and the speed of knowledge acquisition. In Paechter et al.'s (2013) validation study, the questionnaire shows a stable factor structure, sufficient reliabilities, and weak relationships with learning strategies. An additional study confirms the factor structure and reliabilities for business administration student teachers and prospective bank management assistants (Berding et al., 2015). In line with Hofer and Pintrich (1997), beliefs about the control of learning processes and the speed of knowledge acquisition are *not* regarded as epistemic beliefs, so they are not part of the current study. All values are scored in a way that high values indicate more sophisticated epistemic beliefs.

Topic-specific epistemic beliefs: The Instrument for Measuring Epistemic Beliefs in Accounting (IMEB-A) (Berding, 2016) and the Instrument for Measuring Epistemic Beliefs in Marketing (IMEB-M) (Berding, 2017) are applied to assess the topic-specific beliefs. Both questionnaires quantify beliefs about the source, structure, applicability, certainty, and justification of knowledge based on Hofer and Pintrich's (1997) model. Participants rate their agreement on a seven-point scale ranging from "0 = *I do not agree*" to "6 = *I agree*" (e.g., "I believe that new opportunities for payment and contract conditions will be developed and/or discovered in the future"). In the validation studies, both questionnaires reveal stable factor structures, discriminant scales, and high reliabilities of about at least .700 (Berding, 2016, 2017). All values are scored in a way that high values indicate more sophisticated epistemic beliefs.

Learning process and outcome: All participants report their grades in accounting and marketing related topics. In Germany, grades range between "1 = *very good*" to "6 = *insufficient*". If an apprentice reports more than one grade for marketing or accounting respectively, an average value is computed as an achievement indicator. Furthermore, all industrial business management assistants fill out the motivation scale developed by Prenzel, Kristen, Dengler, Ettle, and Beer (1996) which is adapted for marketing and accounting. This questionnaire is mainly based on the Self-Determination Theory of Motivation (e.g., Deci & Ryan, 2012; Ryan & Deci, 2002), and comprises six latent constructs: amotivation, external regulation, introjected regulation, identified regulation, intrinsic regulation, and interest. Individuals rate a frequency on a six-point scale ranging from "0 = *never*" to "5 = *very often*" (e.g., "When learning I was curious"). To compute a motivation indicator, the scores for identified regulation, intrinsic regulation, and interest are aggregated, and the scores for amotivation, external regulation, and introjected regulation are subtracted. Finally, the scores are divided by six. High scores indicate a self-determined quality of behavior.

4.3 Analysis

A second order confirmatory factor analysis is conducted to address research hypothesis (H1). The model contains twelve first-order factors representing the two general and ten topic-specific epistemic beliefs. These constructs are indicated by the items of the OLEQ, IMEB-M, and IMEB-A. Furthermore, the model comprises five second-order factors describing the domain-specific beliefs. They are indicated by the corresponding topic-specific epistemic beliefs and can be interpreted as beliefs about business administration (e.g., beliefs about the source of knowledge in accounting *and* marketing indicate the domain-specific beliefs about the source of knowledge in business administration). The idea behind this approach is that the corresponding topic-specific beliefs (e.g., source in accounting and marketing) are influenced by a superordinate factor (e.g., source in business administration). Accordingly, if the domain-specific level exists, five factors are expected to appear (one for source, structure, applicability, certainty, and justification), explaining the corresponding topic-specific beliefs. The corresponding factor loadings are restricted as being equal to take into account that the domain-specific level should explain the

topic-specific beliefs in accounting as well as in marketing. Figure 2 presents the model.

Missing data is treated with multiple imputation (IM) generating 100 datasets. Age, gender, profession, year of training, and participants' educational level serve as auxiliary variables, improving the quality of the data as a result (e.g., Enders, 2013).

To test hypotheses (H2) and (H3), a multiple hierarchical regression analysis is performed separately for motivation and achievement. The next section presents the results.

5. Results

5.1 Proving the Differentiation into General, Domain-Specific, and Topic-Specific Epistemic Beliefs

The distribution of the data is analyzed prior to conducting CFA. The absolute value of the univariate skew does not exceed 0.844, and the univariate kurtosis is at most 1.045. These are within the range for a moderate violation of normal distribution (|skew| < 2, |kurtosis| < 7), and allow the application of the maximum likelihood algorithm (West, Finch, & Curran, 1995). CFA reveals the following results for the global model fit: $\chi^2(2674) = 9236.38$, $p < .01$; RMSEA: .050; RMSEA CI90: [.049; .051]; SRMR: .068; CFI: .699.

Table 1. Mean, Standard Deviation, and Cronbach's α for Epistemic Beliefs, Achievement, and Motivation

	M	*SD*	α
Source			
General	3.00	0.72	.53
Domain-specific	3.03	0.77	-
Accounting	3.05	0.93	.78
Marketing	3.02	0.87	.72
Structure			
General	3.03	0.74	.59
Domain-specific	3.80	0.72	-
Accounting	3.52	0.89	.76
Marketing	4.06	0.83	.73
Applicability			
Domain-specific	2.80	0.80	-
Accounting	2.44	1.05	.76
Marketing	3.17	0.87	.71
Certainty			
Domain-specific	3.80	0.81	-
Accounting	3.44	0.97	.83
Marketing	4.15	0.93	.74
Justification			
Domain-specific	3.42	0.77	-
Accounting	3.58	1.01	.85
Marketing	3.26	0.81	.71
Achievement			
Accounting	2.40	0.80	-
Marketing	2.32	0.81	-
Motivation			
Accounting	-0.14	0.75	-
Marketing	0.26	0.65	-

According to Hu and Bentler's (1999) combinational rule, RMSEA below .06 and SRMR below .09 indicate a global model fit. CFI values below .950 indicate a global model misfit (e.g., Hu & Bentler, 1999). However, the model evaluation is based only on the combinational rule because CFI compares the hypothetical model with a baseline model. The baseline model assumes all observed variables to be uncorrelated, which is typically inappropriate for most scientific applications (Kline, 2005). As Heene, Hilbert, Draxler, Ziegler, and Bühner (2011) argue, decreased factor loadings generally imply reduced correlations between observed variables and lead to a lower CFI.

Psychological tests on the other hand only seldom achieve high factor loadings (Heene et al., 2011). Furthermore, only low to moderate correlations are expected between the different levels of epistemic beliefs because the domain-specific and topic-specific levels develop form more general beliefs and become more influential (e.g., Bråten et al., 2008; Buehl & Alexander, 2006; Muis et al., 2006). This allows a global model fit to be assumed.

All factor loadings of the measurement model of the OLEQ, IMEB-A, and IMEB-M are positive and significant at the 1% level, indicating a local model fit. Figure 2 presents the central results for the structural model. All factor loadings between the domain-specific and topic-specific beliefs are positive and significant at the 1% level, and are in line with theoretical expectations. Because a weak positive relationship could be estimated, the correlation between the general and domain-specific beliefs about the structure of knowledge is in line with the theory. In contrast, the correlation between the general and domain-specific epistemic beliefs about the source of knowledge is not significant. However, this does not indicate a local misfit because general and domain-specific beliefs represent separate levels. All in all, the results indicate a local model fit, meaning that a general, domain-specific, and topic-specific level of epistemic beliefs can be assumed. Table 1 reports descriptive statistics for the constructs of the current study.

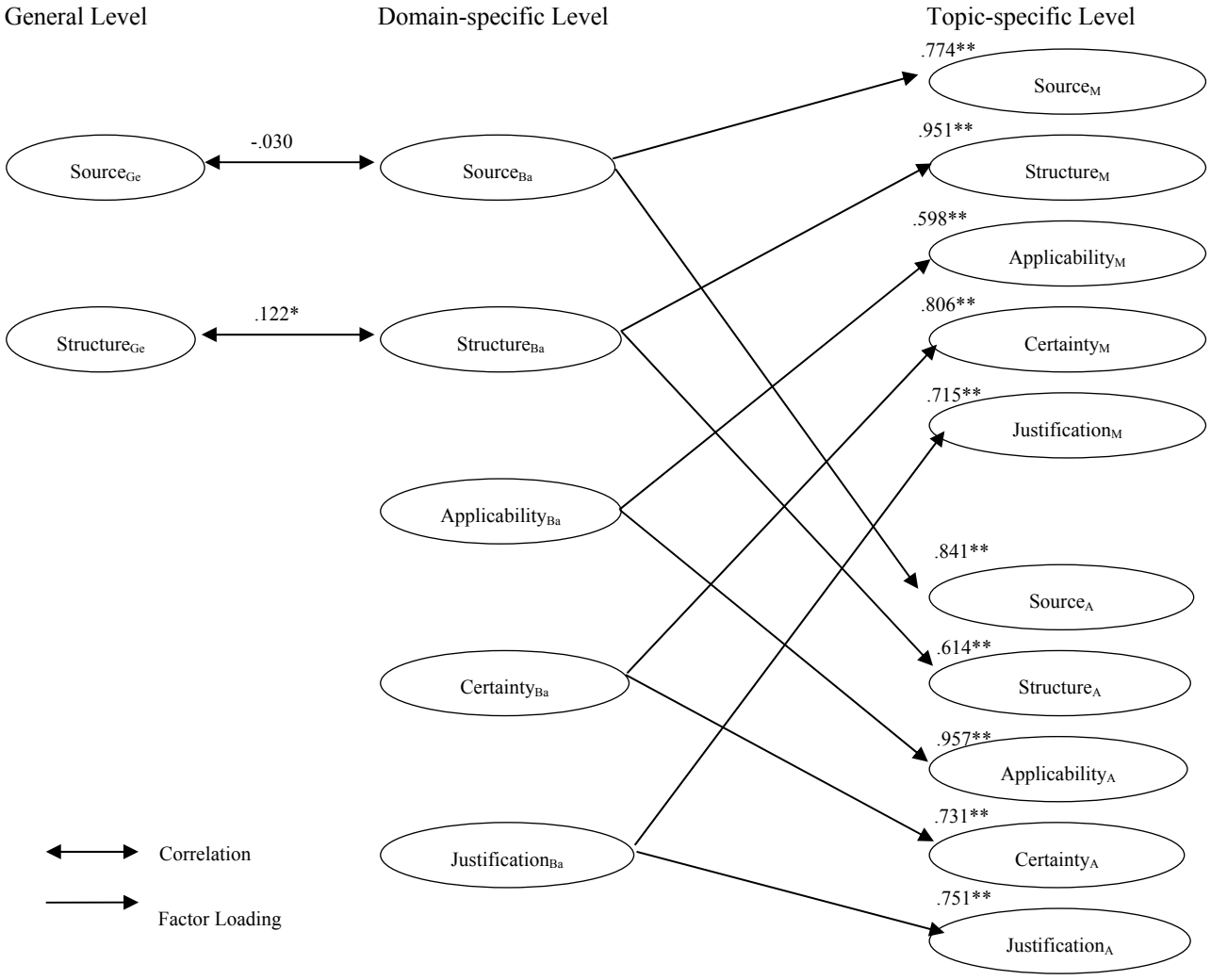

Figure 2. Structural Model for the Levels of Epistemic Beliefs ($N = 975$)

Note. The figure does not show correlations between source$_{Ge}$, structure$_{Ge}$, applicability$_{Ba}$, certainty$_{Ba}$, and justification$_{Ba}$.
Ge = General, Ba = Business Administration, A = Accounting, M = Marketing.
* $p < .05$; ** $p < .01$

5.2 Proving the Explanatory Power of Different Levels of Epistemic Beliefs

Multiple hierarchical regression analyses are performed to test hypotheses (H2) and (H3) based on the three levels identified. The analyses apply profession and educational level as control variables for achievement, and educational level as control variable for motivation. Table 2 presents the results.

Table 2. Summary of Hierarchical Regression Analysis for Variables Predicting Achievement and Motivation in Accounting and Marketing

	Achievement				Motivation			
	Accounting		Marketing		Accounting		Marketing	
Predictor	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Model 1	.18**		.16**		.02		.11**	
Control variables[a]								
Model 2	.00		.01		.07**		.03*	
Control variables[a]								
$Source_{Ge}$		-.01		.07		-.05		.11
$Structure_{Ge}$		.06		.03		.28**		.12
Model 3	.02**		.03**		.10**		.15**	
Control variables[a]								
$Source_{Ge}$		-.01		.07		-.02		.02
$Structure_{Ge}$		.07		.02		.30**		.19**
$Source_{Ba}$		.09*		.01		.08		.21**
$Structure_{Ba}$		-.15**		-.08*		-.07		-.15*
$Applicability_{Ba}$		-.01		-.06		-.03		.37**
$Certainty_{Ba}$		.00		-.14**		-.27**		-.06
$Justification_{Ba}$		.07		.01		-.03		.41**
Model 4	.01*		.02**		.12**		.03	
Control variables[a]								
$Source_{Ge}$		-.01		.07		.09		.03
$Structure_{Ge}$		.07		.03		.24**		.14*
$Source_{Ba}$		.13		-.11		-.41**		.42**
$Structure_{Ba}$		-.14		-.04		-.34**		-.09
$Applicability_{Ba}$		.15*		-.10		-.35**		.20
$Certainty_{Ba}$		.07		-.07		.12		-.14
$Justification_{Ba}$		.18*		-.18*		-.27*		.47**
$Source_{Topic}$		-.04		.16*		.57**		-.26*
$Structure_{Topic}$		-.03		-.04		.38**		-.03
$Applicability_{Topic}$		-.21**		.05		.42**		.19
$Certainty_{Topic}$		-.12		-.05		-.11		.01
$Justification_{Topic}$		-.14		.21**		.24		-.05
Total R^2	.21		.22		.31		.32	
N	774		769		260		260	

Note. [a] Control variables include profession and educational level for achievement, and educational level for motivation. Ge = General, Ba = Business Administration.
* $p < .05$; ** $p < .01$

As indicated by an insignificant or low ΔR^2, general epistemic beliefs have only a weak predictive power for both achievement as well as motivation. As soon as the analysis considers the level of domain-specific epistemic beliefs

(Model 3), R^2 increases significantly between two and three percentage points for achievement and ten and fifteen percentage points for motivation. As a result, domain-specific epistemic beliefs predict learning processes and outcomes more strongly than general epistemic beliefs, confirming hypothesis (H2).

Except for motivation in marketing, adding topic-specific epistemic beliefs to the analysis (Model 4) significantly increases R^2 between one and twelve percentage points. Only in the case of motivation in accounting does the level of topic-specific epistemic beliefs have more explanatory power than the domain-specific level. This is because ΔR^2 of the topic-specific level exceeds the ΔR^2 for the domain-specific level. (H3) is therefore only confirmed for motivation in accounting. The next section discusses the results.

6. Discussion

Current research assumes a multi-level conception of epistemic beliefs comprising general, domain-specific, and topic-specific beliefs (e.g., Bråten et al., 2008; Buehl & Alexander, 2006; Greene & Yu, 2014; Muis et al., 2006). Models describing the relationships between these different levels expect that domain- and topic-specific epistemic beliefs develop from more general beliefs and become more influential for learning processes and outcomes (e.g., Bråten et al., 2008; Buehl & Alexander, 2006; Muis et al., 2006). The current study supports these models. Second-order CFA confirms three levels and provides evidence of five superordinate factors explaining the variance of the topic-specific epistemic beliefs. The existence of a domain-specific level between general and topic-specific beliefs for each dimension can be assumed as a result.

A low to moderate correlation between general and domain-specific beliefs about the structure of knowledge could be found. Apprentices generally believing in complex knowledge are more likely to assume complex knowledge in business administration as well. This seems plausible because domain-specific beliefs develop from more general beliefs (e.g., Buehl & Alexander, 2006; Muis et al., 2006). In contrast, no relationship between the general and domain-specific beliefs of the source of knowledge could be identified. The reason for this finding may be that the domain-specific epistemic beliefs are inferred from the topic-specific beliefs describing a perspective of knowledge and knowing in professional situations. These situations differ from apprentices' private lives. In companies they have the role of learners and are guided by management. They have to perform occupational tasks. This in turn can ultimately mean that general and domain-specific beliefs may in fact become independent.

In line with the models proposed by Muis et al. (2006) and Buehl and Alexander (2006), domain-specific epistemic beliefs have more predictive power than general epistemic beliefs. In contrast, with the exception of motivation in accounting, topic-specific epistemic beliefs do not predict learning processes and outcomes more strongly than domain-specific beliefs. This finding at first glance appears to contradict Bråten et al.'s (2008) idea that topic-specific beliefs have a greater impact on learning phenomena because they are more closely related to learning processes. However, topic-specific epistemic beliefs provide unique variance in predicting motivation in accounting and achievement in accounting as well as in marketing. So the domain-specific cannot replace the topic-specific level. Based on the results of this study, it is reasonable to assume that topic-specific and domain-specific epistemic beliefs describe different facets of learning processes and outcomes. For example, the more apprentices believe that knowledge in business administration is relevant for finding solutions in professional situations, the poorer their grades are in accounting (domain-specific level). At the same time, apprentices achieve better grades in accounting the more they believe that knowledge in accounting is relevant for professional situations (topic-specific level). The reason for these results may be that believing in applicable business administration knowledge is relevant and important for dealing with different aspects of companies (e.g., marketing, accounting, production, human resources, etc.). To handle all these aspects in everyday practice, strict, narrow rules make finding a solution difficult. In accounting however, these kinds of narrow rules are essential. As a result, the loose reference to rules on a domain-specific level may explain lower grades in accounting. At the same time, believing in applicable accounting knowledge provides a strong motivation for learning these narrow rules, leading to better grades as a result (e.g., Table 2). In the case of motivation in accounting, believing in complex business administration knowledge (domain-specific level) decreases motivation, while believing in complex accounting knowledge (topic-specific level) increases motivation. The reason for this may be that learners feel overwhelmed by the complexity of an entire company and the need to represent this company complexity within accounting. In contrast, experiencing only accounting knowledge as complex may increase the motivation to learn accounting because learners realize how the different accounting rules and systems work together and influence each other. Future research as a result should concentrate on the domain- *and* topic-specific levels for analyzing learning processes and outcomes.

Further studies should abandon general epistemic beliefs and concentrate on domain- and topic-specific epistemic beliefs for analyzing learning phenomena. These levels of specificity provide stronger predictors and offer the opportunity for a deeper understanding of learning processes and outcomes. Because they appear to describe different facets of learning, it will continue to be important to consider both domain- *and* topic-specific epistemic beliefs in research.

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