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Elementary and Middle School Students' Conceptions of Knowledge, Information, and Truth

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Although the study of epistemic beliefs has received growing interest in the past decades, this research tends to focus on high school and undergraduate students, and does not address beliefs about information and truth, concepts that have been regarded as critical for learners in 21st-century educational contexts. In this study, the authors examined 87 elementary and middle school students' beliefs about the definitions of and relations among knowledge, information, and truth through the use of a graphical and justification task, and addressed the consistency of beliefs across contexts and domains. Results indicated that students tended to regard knowledge, information, and truth as interrelated, and the majority of students described their beliefs as consistent across contexts and domains.

Keywords *epistemic beliefs, information, knowledge, truth*

CHANGES IN TECHNOLOGY have altered the accessibility of knowledge and information for students growing up in the 21st century more than at any other time in history (Coiro, 2003). While technology-rich environments provide numerous benefits for learning and instruction (Arsham, 2002; Cold, 2006; Perse & Ferguson, 2000), these contexts pose certain challenges. In these contexts, presenting students with educational tasks such as searching for, selecting, and using sources (Bråten, & Strømsø, 2010; Salmerón, Gil, Bråten, & Strømsø, 2010) requires them to search for information, develop knowledge, and to determine its veracity. However, there has been little research into students' beliefs about knowledge, information, and truth (Alexander, Winters, Loughlin, & Grossnickle, 2012), particularly in terms of how young students living in today's information-saturated culture conceptualize the interplay of these critical constructs and whether they believe that their understandings are consistent across the various domains and contexts in which they engage.

As evidence of the critical nature of knowledge, information, and truth for students today, authors of recently developed curricular materials, such as the Common Core State Standards in the United States (Common Core State Standards Initiative, 2012), have used these terms to characterize learning goals. They emphasize that students should be able to "integrate visual information" in history (CCSS.ELA-LITERACY.RH.6-8.7, 2012), "provide an accurate summary of the text distinct from prior knowledge" in science (CCSS.ELA-LITERACY.RST.6-8.2, 2012),

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evaluate the validity of reasoning in texts, and "explore the truth of their conjectures" in math CCSS.MATH.PRACTICE.MP3, 2012). While it would appear that terms such as *knowledge*, *information*, and *truth* have significance to those crafting these instructional goals, their meaning to the children to whom they are directed remains unexplored. Thus, before we can address students' skills and capacities in accomplishing these skills, we must first consider students' understandings of these concepts, and determine whether these beliefs are general in nature or whether they are specific to domains and contexts.

Epistemic Beliefs

Of these three constructs (i.e., knowledge, information, and truth) important for students in the digital age, educational psychologists have focused almost solely on knowledge. The study of students' beliefs about knowledge and knowing, epistemic beliefs, have a history in the educational psychology literature extending over more than four decades (Hofer & Pintrich, 1997; Muis, Bendixen, & Haerle, 2006; Perry, 1970). Epistemic beliefs differ from formal epistemologies, conceptions of the nature of knowledge held by those engaged in the study of knowledge, in that they represent the beliefs of everyday individuals rather than experts (Kitchener, 2002). While formal epistemologies provide an understanding of the nature of knowledge from an expert and philosophical perspective, students are not expected to hold such formal or studied conceptions (Murphy, Alexander, Greene, & Hennessey, 2012). Moreover, their self-reported ideas about knowledge and knowing are not necessarily enacted in their everyday practices (Sandoval, 2004a, 2004b). As such, the present study aligns with the perspective of epistemic beliefs as a means of uncovering the emerging understandings of children and adolescents who are not regarded as holding formal epistemologies.

Under the umbrella of epistemic beliefs, researchers have examined students' beliefs such as the source of knowledge, the evidence necessary to substantiate knowledge, and the degree to which knowing is an effortful endeavor (Greene, Azevedo, & Torney-Purta, 2008; Hofer, 2004; Schommer, 1990). Research has consistently demonstrated that epistemic beliefs influence learning, and that individuals who believe knowledge to be complex, uncertain, effortful, and requiring justification tend to be more successful in academic tasks (Bendixen & Hartley, 2003; Bråten, Britt, Strømsø, & Rouet, 2011; Hofer, 2004). Moreover, epistemic beliefs have been identified as a critical factor in learning, and have been implicated in students' text comprehension (Bråten et al., 2011; Ferguson & Bråten, 2013), use of learning strategies (Pieschl, Stahl, & Bromme, 2008), and eye movements during reading (Kammerer & Gerjets, 2012). Students' epistemic beliefs have also been found to relate to their achievement motivation, with certain configurations of epistemic beliefs associated with motivations more conducive to learning for undergraduates (Buehl & Alexander, 2005; Chen, 2012; Ricco, Schyuten Pierce, & Medinilla, 2010) as well as elementary and middle school students (Conley, Pintrich, Vekiri, & Harrison, 2004; Ricco et al., 2010; Schommer-Aikens, Duell, & Hutter, 2005).

Since early conceptualizations, epistemic beliefs have been regarded as developing across an individual's life and educational experience, although theorists differ in their explanation of the nature of these developmental changes. For example, in his seminal research with undergraduates, Perry (1970) categorized individuals' epistemic beliefs according to six stages, progressing from least to most advanced. Baxter Magolda (2004), King and Kitchener (2004), Kuhn and colleagues (Kuhn, 1991; Kuhn, Cheney, & Weinstock, 2000), and Greene and colleagues (2008)

also forwarded models of developmental changes in individuals' beliefs about knowledge and knowing. For example, they proposed that individuals' beliefs about the complexity of knowledge, the effort required to know, and the types of justifications deemed necessary develop across the lifespan and throughout schooling. Schommer (1990) also addressed the developmental nature of epistemic beliefs. However, in contrast with the unidimensional nature of beliefs in Perry's (1970) theory, Schommer (1990) proposed a model with four dimensions of beliefs. Within this model, Schommer (1990) identified the nature of beliefs along each of the proposed dimensions as more or less sophisticated.

Consistent with Schommer's (1990) theory, contemporary researchers have typically regarded beliefs about knowledge as developmental and multidimensional in nature (Greene et al., 2008; Hofer & Pintrich, 1997). Whether these characteristics extend to beliefs about information, truth, and their interrelations with knowledge has yet to be uncovered. Although epistemic beliefs do not address beliefs about information or truth, the overarching framework of beliefs as developmental and multidimensional has the potential to inform how beliefs about information and truth are investigated. Specifically, those engaged in the study of epistemic beliefs frequently acknowledge the importance of examining beliefs across differing developmental levels (Metz, 2011; Yang & Tsai, 2010). While literature has tended to focus on older students (e.g., Chen, 2012; Perry, 1970), the present study provided the opportunity to examine beliefs in younger students. As such, we purposefully selected students in late elementary school and middle school.

Furthermore, in the current study we elicited participants' characterizations of the nature of each of the constructs and their interrelations, allowing them to discuss any facets of the constructs and relations that they regarded as pertinent. Providing for the potential consideration of multiple aspects of each construct (e.g., overlap of knowledge and information or importance of knowledge) relates loosely to prior conceptualizations of epistemic beliefs as multidimensional (Schommer, 1990) in that it allows for different features to be considered (e.g., how truthful is information or how important is truth). However, these ways of conceptualizing constructs and their relations is not a direct mapping onto Schommer's (1990) theory and varies from the dimensions of beliefs about knowledge put forward in multidimensional theories of epistemic beliefs. Also, it differs from traditional measures of epistemic beliefs in which individuals are typically required to report their beliefs along specified dimensions. Moreover, self-report measures of epistemic beliefs often use the terms *knowledge*, *information*, and *truth* fairly loosely and interchangeably. As such, researchers in the field need to understand the degree to which people throughout the lifespan view these terms differently and how the specific terms included might affect responses.

Beliefs about Knowledge, Information, and Truth

Recent efforts in the literature have advocated for a move beyond considering only students' beliefs about knowledge and knowing, to include beliefs about information and truth. Researchers (e.g., Alexander and Disciplined Reading and Learning Research Laboratory, 2010; Lankshear, 2003; Lankshear, Peters, & Knobel, 2000) have highlighted the importance of information and truth for today's learners, and examined the relation that these constructs have to knowledge, particularly for students working within online contexts. Given the amount of information available to students, it is no longer sufficient to only consider their beliefs about knowledge (Alexander &

the Disciplined Reading and Learning Research Laboratory, 2012). Rather, as Lankshear and colleagues (2000) argued, beliefs about knowledge and information should be considered in concert and not in isolation. In particular, Lankshear and Knobel (2006) contended that the introduction of the Internet brought the demand for students to use information effectively and to apply truth criteria to information online, as well as offline. Other researchers examining online text processing, including multiple source use, would concur with that contention (Braasch, Bråten, Strømsø, Anmarkrud, & Ferguson, 2013; Stadtler & Bromme, 2008).

While making the distinction between knowledge and information has potential benefits for students navigating the online world, whether they do so is a question addressed in the current study. For educators, understanding how students conceptualize the differences and relations between knowledge and information may provide insights into how students can be aided in their efforts to disentangle knowledge and information particularly within online contexts. Moreover, it is acknowledged that all knowledge and information on the Internet must be evaluated relative to whether or not they constitute *truth* (Lankshear et al., 2000). For example, Lankshear (2003) noted that within the digital age, the presentation of truth has shifted away from the centuries-old tradition of the printed word.

At the same time the Internet is frequently used as a definite source of authority, leading to a call to evaluate information (Lankshear et al., 2000; Stadtler & Bromme, 2008) and to reexamine what constitutes truth for students (Bråten & Strømsø, 2005; Lankshear, 2003). For students who commonly use the Internet to obtain knowledge and information, identifying that knowledge and information can have relative truthfulness is an important step in critically evaluating online sources (Grossnickle, List, & Alexander, in press; Maggioni, Fox, & Alexander, 2010). For instructors, uncovering this understanding of students' beliefs about truth in relation to knowledge and information could prove informative for addressing issues of verification (King & Kitchener, 2004). For these reasons, examining students' beliefs within a larger framework of beliefs about knowledge, information, and truth has the potential to provide a broader picture of their academic lives.

Theoretical conceptions of knowledge, information, truth, and their interrelations have been put forward in the fields of philosophy, information science, and knowledge management, in addition to education. For example, in the educational literature, the terms *knowledge* and *information* are frequently used interchangeably (Kettinger & Li, 2010), even when they are acknowledged by some as distinct, but related, concepts (Ackoff, 1989; Floridi, 2010). Diverging theories have been proposed to explain the relation between knowledge and information, although the theories typically describe the relation in a procedural fashion. For example, some regard knowledge as a necessary precursor for the shaping and filtering of information (Kettinger & Li, 2010; Tuomi, 1999), such that individuals cannot make sense of information without first having some prior knowledge. In contrast, others have identified information as a precursor to knowledge (Ackoff, 1989; Rowley, 2007), suggesting that information is transformed into the knowledge of an individual or society.

Another major theory depicts a more iterative process between knowledge and information, noting that prior knowledge shapes what information is identified and comprehended, and that some of the available information is then transformed into knowledge that can be used for the interpretation of future information (Mingers, 2008). As is evident by these contrasting theories, knowledge can be regarded as individual (e.g., prior knowledge) or social (e.g., cultural norms or disciplinary conventions) in nature. Similarly, information and truth have been perceived as both

individually determined (Ackoff, 1989; Kettinger & Li, 2010) and socially agreed-upon (Hesse, 1980; Minges, 2008). In relation to knowledge and information, truth typically is discussed in terms of the degree of its relation, or put forward as a defining feature of knowledge (e.g., knowledge as justified true beliefs) and information (e.g., information requires truth; Dretske, 1981; Grice, 1957). Moreover, whether only information with an underlying truth should be recognized as information has received considerable debate (Case, 2002; Floridi, 2004). However, little is known about the extent to which lay-people, and particularly young children, hold these types of theoretically aligned conceptions of knowledge, information, and truth. While the focus of this study was on the beliefs of everyday individuals, these formal epistemologies and theories guided our interpretations of the ways in which these constructs could be conceptualized individually and in concert in the words and phrases of elementary and middle school students.

A recent investigation of undergraduate students' beliefs about knowledge, information, and truth (Alexander et al., 2012) is the only study of which we are aware that has examined students' beliefs about all three constructs. In this study, researchers uncovered undergraduate students' beliefs about knowledge, information, and truth using a graphical depiction and verbal justification task. Similar to discourse in the fields of education, philosophy, information science, and knowledge management, undergraduate students most often described the relation among knowledge, information, and truth as procedural. Participants frequently depicted knowledge and information as creating truth, or regarded information and truth as leading to knowledge. When asked to define knowledge and information, undergraduates in the study by Alexander and colleagues (2012) typically defined them in relation to one another, or as they related to *data*. The participants frequently defined truth using words such as *real*, *valid*, and *fact/factual*, in addition to including *knowledge* and *information* in their definitions. The present investigation builds directly on this study to examine beliefs about knowledge, information, and truth in children and early adolescents. Because of the paucity of research on beliefs about knowledge, information, and truth, and the focus on beliefs about knowledge, one of the central constructs of the study, epistemic beliefs are used as a guiding framework for understanding beliefs in younger students and their beliefs about domain and context specificity versus generality.

Epistemic Beliefs in Children and Adolescents

Despite the developmental focus of theories of epistemic beliefs, researchers in this area have focused primarily on undergraduates and to some extent high school students. This emphasis has been retained in the decades of research since Perry's (1970) initial investigations with Harvard undergraduates, with few researchers examining beliefs in younger learners. Despite limited investigations, theoretical and empirical research points to the importance of understanding epistemic beliefs in children and adolescents before they reach high school. Piaget's (1929/1951) theory of genetic epistemology has served as a foundation for understanding the development of children's and adolescents' beliefs about knowledge. His theory addresses the sources of knowledge across a portion of lifespan, from sensory and motor perceptions to hypothetical and deductive reasoning, and points to the importance of investigations into knowledge beliefs (Ginsburg & Opper, 1988).

Recently, researchers have indicated that epistemic beliefs can be assessed in children as young as preschool (Burr & Hofer, 2002; Metz, 2011), when developmentally appropriate tasks are used.

In a study of first-grade students' reasoning while designing their own scientific experiments, Metz (2011) indicated that even at this young age, many students are nonetheless able to articulate their beliefs about the nature of knowledge. In late elementary school and middle school, interview protocols have been successfully used as a means of providing students with a developmentally appropriate way to express their epistemic beliefs (Tsai, 1998; Yang & Tsai, 2010). In these studies, students' epistemic beliefs related to their learning strategies and preference for learning activities (Tsai, 1998) as well as their ability to connect scientific theory and evidence (Yang & Tsai, 2010).

Some researchers have suggested that the scores of elementary school and middle school students on questionnaire measures indicate relatively sophisticated beliefs (Conley et al., 2004; Elder, 2002), particularly when compared with earlier views that more sophisticated beliefs only emerge following college coursework (e.g., Perry, 1970). The structure of beliefs identified in middle school students bears some resemblance to beliefs in undergraduate samples (Mason, 2000; Schommer-Aikens et al., 2005; Schommer-Aikens et al., 2000), including the categories of beliefs present and their relation to learning outcomes. Using questionnaire measures, epistemic beliefs of middle school students have been found to relate to measures of learning and processing, including students with beliefs supporting the certainty of knowledge more likely to accept anomalous data (Mason, 2000). However, there were certain notable differences, such as a simpler factor structure uncovered for middle school students (Schommer-Aikens et al., 2000). Furthermore, in contrast with more sophisticated beliefs identified through questionnaires, interview methods probing sixth-grade students' epistemic beliefs about science revealed that students at this age tended to support absolutist beliefs about the certainty of knowledge and the nature of knowing (Yang & Tsai, 2010).

For students in late elementary school and middle school, more traditional self-report measures have been commonly used (Mason, 2000; Ricco et al., 2010; Schommer-Aikens, Mau, Brookhart, & Hutter, 2000), with some notable exceptions (Tsai, 1998; Yang & Tsai, 2010). In younger samples, questionnaire measures have presented similar challenges to the use of self-report measures in college students, including potential confusion associated with item wording (DeBacker, Crowson, Beesley, Thoma, & Hesterold, 2008; Moschner, Anschuetz, Wernke, & Wagener, 2008). For example, questions regarding the reliability and validity of questionnaire measures, such as whether young children can understand epistemic beliefs questionnaire items as intended, have been noted (Moschner et al., 2008). From these studies, researchers indicate that while epistemic beliefs can be assessed in young populations, varied measures should be used to capture the range of beliefs that young students espouse. The current study was built on the developmental and multidimensional frameworks of epistemic beliefs to examine beliefs about knowledge, information, and truth. We included measures of beliefs about knowledge, information, and truth for one particular developmental range, and aimed to uncover how individuals position knowledge, information, and truth relative to each other.

Domain and Context Specificity Versus Generality

In the literature on epistemic beliefs, there have been theoretical and empirical investigations into the consistency of students' beliefs and whether they hold across domains and contexts. Initially, beliefs were examined in a domain-general format that included a developmental progression of epistemic beliefs across age and academic experience (Greene et al., 2008; Hofer

& Pintrich, 1997). However, recent epistemic beliefs research has provided support for both the domain-specificity as well as domain-generality of beliefs (Buehl, Alexander, & Murphy, 2002), suggesting that domain-general and domain-specific beliefs work in tandem (Muis et al., 2006). When examining the multidimensionality of beliefs, there is evidence that similar dimensions emerge across domains (Buehl & Alexander, 2005; Hofer, 2000). Students also tend to be consistent in their degree of sophistication of beliefs across domains (Buehl & Alexander, 2005), suggesting at least some underlying domain-general beliefs.

Nevertheless, disciplinary differences in epistemic beliefs have been identified in students across different domains with regard to the degree to which they endorse beliefs, such as the certainty of knowledge (Jehng, Johnson, & Anderson, 1993; Paulsen & Wells, 1998; Trautwein & Lüdtke, 2007a). Within-student differences have also been identified across domains, including differences in the degree to which students view the simplicity and certainty of knowledge (Jehng et al., 1993; Trautwein & Lüdtke, 2007b), the structure of knowledge (Stahl & Bromme, 2007), and the nature of justifications that they deem appropriate across domains (Hofer, 2000). Furthermore, differences have been identified in the degree to which beliefs relate to performance across domains (Beghetto & Baxter, 2012). The domain-specific nature of epistemic beliefs is often attributed to different underlying epistemologies across domains, frequently in relation to whether the domain is well-structured (i.e., algorithmically based) or ill-structured (i.e., heuristic based; Buehl & Alexander, 2005; Muis et al., 2006). Accordingly, in the present study, we included domains that are typically depicted as more ill-structured (i.e., social studies) and more well-structured (i.e., mathematics) to examine whether students' regard their beliefs to hold across domains.

Another source of differences in epistemic beliefs may lie in the context of the situation in which beliefs are enacted. Within individuals, it is proposed that different epistemic beliefs may be more conducive for varied contexts, including differing classroom situations, and between classroom and non-classroom contexts (Bråten, Gil, Strømsø, & Vidal-Abarca, 2009; Karabenick & Moosa, 2005; Maggioni & Parkinson, 2008). For example, the justifications for knowledge and the degree to which knowledge is viewed as complex and uncertain might reasonably differ depending on whether a student is researching a medical condition for an academic report or for his or her own personal understanding at home. While in the present study we do not explicitly address whether elementary and middle school students hold different configurations of beliefs in different domains, we examine whether context and domain differences evidenced in prior research on epistemic beliefs are represented in the beliefs held by students when reporting their understandings of the interrelations among knowledge, information, and truth.

The Present Study

In this study, we built on prior research in four significant ways. First, to extend research on epistemic beliefs to additional epistemic-related constructs, we aimed to examine beliefs about information and truth in addition to students' beliefs about knowledge, and to investigate beliefs about the interrelations among these constructs. Second, given the potential importance of such beliefs for students at academic levels prior to college, this study aimed to examine beliefs in students at the upper elementary school and middle school level. We determined that upper elementary school and middle school students could provide insight into their beliefs about knowledge, information, and truth if given appropriate tasks and opportunities to do so. Third, this

study moved beyond traditional self-report questionnaires of students' beliefs, as is typically done in the epistemic beliefs literature. In doing so we devised tasks that allowed students to visually and verbally construct representations and justifications of their beliefs about information and truth in concert with knowledge in a structured progression of tasks. Last, building on epistemic beliefs research we examined the stability of students' beliefs across contexts and domains. We addressed the following three research questions:

1. What words do elementary school and middle school students use to define knowledge, information, and truth?
2. How do elementary school and middle school students conceptualize the relations among knowledge, information, and truth and justify their conceptions?
3. To what extent do elementary school and middle school students believe that the relations among knowledge, information, and truth hold across differing domains and varying contexts?

Given the exploratory nature of this investigation into the beliefs about knowledge, information, and truth of elementary and middle school students, we were unsure whether the nature of students' beliefs would parallel those documented in undergraduates (Alexander et al., 2012), common conceptualizations of these beliefs from the literature (e.g., Ackoff, 1989; Floridi, 2004; Mingers, 2008), or other variations of possible belief configurations. The tasks used in this study were based on graphical and justification tasks used in previous studies (Alexander & Dochy, 1995; Maggioni, Riconscente, & Alexander, 2006). In those aforementioned studies, students' understandings of the constructs *knowledge* and *beliefs* were examined by providing them with sets of graphical images depicting knowledge and beliefs as circles with varying degrees of interrelations—from complete separateness to complete overlap. After selecting a graphic that students regarded as representing their understanding of the relation between knowledge and beliefs, they were asked to justify their selection and explain why it best represented the relation among the constructs. In these prior studies, researchers designed these tasks to allow students greater freedom in their depictions, providing a structured task, but allowing for open-ended responses. In the present study, we utilized the combination of graphical and written tasks to afford participants the opportunity to depict their beliefs in different ways suitable for their developmental level and to allow for a concrete and accessible representation of the abstract constructs of knowledge, information, and truth for young students.

METHOD

Participants

Participants were 87 students at a private school for students with reading problems in the mid-Atlantic region of the United States. The school was a combined elementary-middle school. Participants included 59 boys and 27 girls; 1 student did not report gender. Students at this school are assigned to mixed-grade classrooms to reflect homogeneous grouping on the basis of ability. Although the students at this school were identified as having reading or language problems, the school caters to students of average to above average ability, suggesting that while the students are struggling readers, they are not struggling thinkers. The population

served by the school is predominately White and from upper-middle to upper socioeconomic levels.

The students ranged in age from 10 to 15 years ($M = 12.25$, $SD = 1.45$) and were in the fifth through ninth grades. Students were recruited from these grades because we were interested in students' beliefs across upper elementary school and middle school, and we believed that students at these ages would be able to understand the prompts and articulate their beliefs about knowledge, information, and truth. The students' teachers verified the developmental appropriateness of the tasks for this specific population, and indicated that the written responses were typical of assignments that students completed in their coursework. Students were recruited through fliers distributed by their classroom teacher, and students were allowed to participate if they received written parental consent and provided verbal assent at the time of the study. From the recruited classes, 82.1% of students participated in the study.

KIT Bidirectional Conceptualization Task

Description

We were first interested in understanding how students conceptualized the relations among the three constructs of knowledge, information, and truth. To get at these relations, we initially asked students to think about each pair of constructs (i.e., knowledge and information; knowledge and truth; information and truth). For each pair of constructs students were first asked to select the depiction that showed their conception of these constructs and then to justify why they selected their chosen graphic. Specifically, participants were instructed: "Below are pictures that show how kids think differently about the relation between Knowledge (K) and Information (I). Click on the picture that shows how YOU think about the relation between Knowledge (K) and Information (I)." A set of seven graphics depicting possible relations among knowledge and information were provided (see Figure 1), as well as the option for individuals to draw their own graphical depiction. The depictions provided were drawn from theoretical conceptions of these constructs and were designed to represent a range of all possible relations. After selecting or drawing a graphic, participants were provided with an image of their graphic and were asked to justify their depiction. Specifically, they were instructed: "Tell us why you think the picture you chose or drew best shows the relation between Knowledge (K) and Information (I)." A textbox was provided, and there was no word limit. The graphics task was presented first to engage participants in the task. This procedure was repeated for the relation among knowledge and truth, and for information and truth.

Coding

The graphics and justifications were used in conjunction to categorize individuals' beliefs, given that any graphic could be explained in multiple ways. We independently coded responses on the basis of a set of a priori codes for each set of relations, allowing for additional categories to capture the data. Additional categories were discussed and data were then recoded with the revised coding scheme. The coding scheme and sample justifications are provided in Table 1. To establish reliability on the final coding scheme, we coded 42.5% of the knowledge and information relations with $\kappa = .73$, 23.0% of the knowledge and truth relations with $\kappa = .78$,

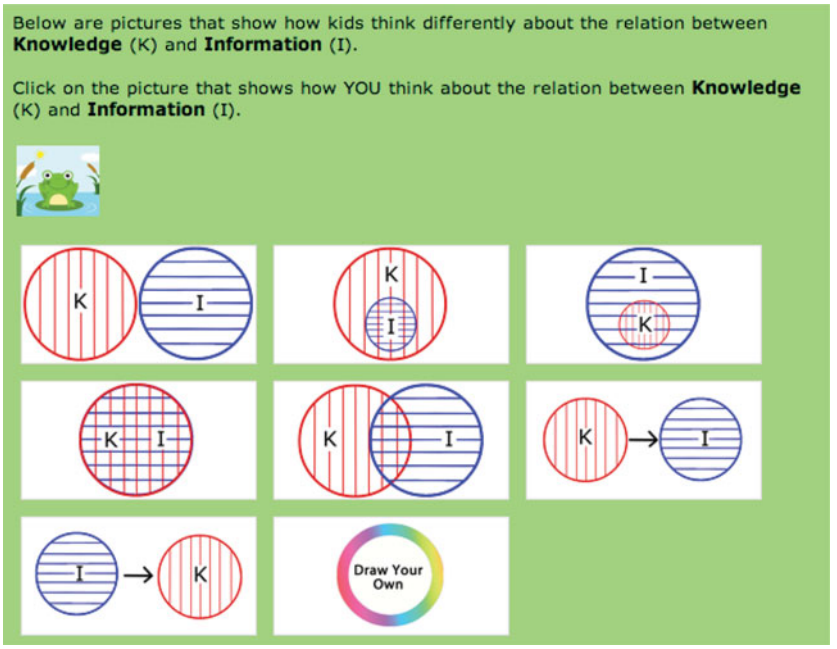

FIGURE 1 Screen shot displaying the directions and options for the knowledge, information, and truth depiction task. The same set of figures was used for participants' beliefs about knowledge and truth, as well as information and truth, with the corresponding letters in the circles adjusted accordingly.

and 47.1% of the information and truth definitions with $\kappa = .73$. While establishing interrater agreement, any inconsistent classifications of codes applied to the justifications were resolved through discussion by the authors to establish a consensus. Then, the first author coded the remainder of the justifications. Justifications were coded as *other* if they did not fit any of the identified categories and *uncodable* if they were left blank or did not mention the terms of focus.

In the descriptions of the codes that follow, it is important to acknowledge that the questions put to the students about knowledge, information, and truth and the responses they provided were not fine-grained enough to allow us to ascertain whether the overall orientation of these children was more individualistic or social in nature. Nonetheless, there will be particular categories of responses identified that do suggest more individualistic orientations, as we will note.

Knowledge and Information

On the basis of participants' graphical selections and justifications, we identified eight categories to describe their beliefs about the relations between information and knowledge, which can be described in terms of the general types of relations depicted. Four of the categories included the degree of relation between the constructs: (a) separate, (b) completely overlapping, (c) partially overlapping, and (d) some information is knowledge; two categories reflected a procedural relation: (e) information leads to knowledge, and (f) knowledge leads to information; one included

TABLE 1
Coding Scheme for Bidirectional Relations Among Knowledge, Information, and Truth

Category	*Description*	*Sample participant justification*
	Knowledge and information relations	
Separate	Knowledge and information are unrelated	"I think knowledge and information are complete different thing because information is true and knowledge could be true or not" (Participant 22)
Completely overlapping	Knowledge and information are synonymous or the same	"Because knowledge and information are the same thing" (Participant 35)
Partially overlapping	Knowledge and information are similar or based on similar things	"Because they are different things but have similar qualities" (Participant 64)
Some information is knowledge	Information is a larger construct with only some information as knowledge	"Because there is an infinite amount of possible knowledge in the universe, and it is only possible to know a little" (Participant 42)
Information leads to knowledge	Knowledge comes from information	"you need to learn information so it becomes knowledge in your head" (Participant 12)
Knowledge leads to information	Use knowledge to get or interpret information	"Because you need to know stuff to have information" (Participant 30)
Importance/amount	Compared relative (or equal) amount or importance of knowledge and information	"because you need a little of both" (Participant 11)
Information is something you know	Use knowledge as a verb to clarify information	"because knowledge is information that you know" (Participant 16)
	Knowledge and truth relations	
Separate	Knowledge and truth are unrelated	"because i think they barley have anything to do with each other" (Participant 77)
Completely overlapping	Knowledge and truth are synonymous or the same; all knowledge is true	"Because the knowledge must be truthful" (Participant 37)
Partially overlapping	Knowledge and truth are similar or based on similar things	"They are mostly the same but have minor differences" (Participant 64)
Some knowledge is true	Some knowledge is true and some knowledge is not true	"Sometimes Knowledge can be truth, but sometimes what you know isn't true" (Participant 32)
Knowledge leads to truth	Use of knowledge to get to or to tell the truth	"I think that knowledge leads to the truth because if you don't have any knowledge than how on earth are you going to know the truth?" (Participant 84)
Truth leads to knowledge	Need for truth to get knowledge	"Because without truth there is not knowledge" (Participant 52)
	Information and truth relations	
Separate	Information and truth are unrelated	"because i think they are completely different things" (Participant 77)

(Continued on next page)

TABLE 1
Coding Scheme for Bidirectional Relations Among Knowledge, Information, and Truth *(Continued)*

Category	*Description*	*Sample participant justification*
Completely overlapping	Information and truth are synonymous or the same; all knowledge is true	"Information is the same as truth" (Participant 68)
Partially overlapping	Information and truth are similar or based on similar things	"because the information inst always true and all true things aren't information" (Participant 74)
Some information is true	Information is not always truthful	"only some infromation is true" (Participant 62)
Information leads to truth	Information is necessary for getting the truth or telling the truth	"because information leads to people knowing the troth" (Participant 16)
Truth leads to information	Truth helps individuals acquire or make sense of information	"Because the truth will give you Information" (Participant 18)

Note. All sample quotations have been left unchanged, including spelling, grammar, and punctuation.

(g) importance/amount; and the final category reflected (h) information as something you know. Among the aforementioned categories, there was one, *information as something you know*, that is suggestive of knowledge as internal and individual in nature, although such an epistemic frame cannot be firmly established given the general character of the children's responses.

Individuals' justifications were coded as *separate* if they described knowledge and information as completely unrelated entities. The *completely overlapping* category included individuals who described knowledge and information as synonymous or the same. Participants with *partially overlapping* justifications noted that the constructs were similar or based on the same things, but did not provide a specific nature of the relation. In the next category students described the terms as nested, with *some information as knowledge*, noting that only some of the available knowledge is information. Whether the available knowledge is personal or social could not be determined from the participants' responses. In the procedural categories, participants who justified the relation as the use of knowledge to get or interpret information fell in the *knowledge leads to information* category. These individuals tended to describe the use of prior knowledge as a means of acquiring information (e.g., "you need knowledge to learn information"), although it was unclear from their responses whether that acquisition would transpire individually or socially.

In contrast, participants in the *information leads to knowledge* category described knowledge as coming from information. These individuals discussed information as turning into or becoming knowledge, for example, describing information in the environment transforming into knowledge held within the individual. For example, one participant noted, "you need to learn information so it becomes knowledge in your head." Other participants discussed these constructs more generically such as, "information leads to knowledge." Furthermore, some individuals' justifications discussed the relative or equal importance or amount of information and knowledge, and were categorized as *importance/amount.* Finally, the category *information is something you know*, included participants who used knowledge as a verb to clarify information (e.g., "knowledge is information that you know"). Justifications that did not fit these categories were coded as *other*

($n = 4$), and justifications that were missing or did not include the terms knowledge and information were coded as *uncodable* ($n = 5$).

Knowledge and Truth

Six categories were created to capture students' beliefs about the relations between knowledge and truth. Similar to the knowledge and information justifications, there were several categories that included the degree of the relation: (a) separate, (b) completely overlapping, (c) partially overlapping, and (d) some knowledge is true. There were also two procedural categories: (e) knowledge leads to truth and (f) truth leads to knowledge.

The *separate* category included justifications of knowledge and truth as unrelated or "not the same," while the *completely overlapping* category included justifications that knowledge and truth are the same, or that all knowledge is true. Participants in the *partially overlapping* category depicted knowledge and truth as similar in some ways and different in others, and those in the *some knowledge is true* category included justifications that described some knowledge as true and some knowledge as not true. Individuals with procedural justifications either described the use of knowledge to get truth or to tell the truth (*knowledge leads to truth*) or a need for truth to obtain knowledge (*truth leads to knowledge*). The *knowledge leads to truth* category comprised participants who described knowledge as a means of understanding truth or knowledge as something that people use to tell the truth. For example, one participant explained that "knowledge leads to truth"; and another participant elaborated, explaining, "The knowledge you [know] will help you decide what information you [know] is the truth." The *truth leads to knowledge* category included descriptions that knowing the truth results in knowledge (e.g., "You need the truth to get your knowledge"). There were 10 justifications (11.49%) coded *other* and 8 justifications coded *uncodable* (9.20%).

Information and Truth

The six categories used to classify justifications of the relation between knowledge and truth mirrored those used to classify knowledge and truth. We created four categories to describe the degree of the relation between the terms: (a) separate, (b) completely overlapping, (c) partially overlapping, and (d) some information is true; and two categories to depict a procedural relation: (e) information leads to truth and (f) truth leads to information.

Participants in the *separate* category described knowledge and information as unrelated, whereas those in the *completely overlapping* category described the terms as the same, or noted that all information is true. In the *partially overlapping* category participants' justifications depicted the terms as similar or almost the same. Others focused on information as not always truthful, and their justifications were categorized in the *only some information is true* category. In terms of procedural relations, participants who justified information as a necessary condition for getting the truth or for telling the truth were classified in the *information leads to truth* category. For example, one participant suggested that "information leads to people knowing the [truth]." In contrast, justifications were classified as *truth leads to information* if they included descriptions of truth as helping individuals acquire or make sense of information. As one participant explained,

"With truth, you can develop information and be able to make sense of the truth through information." There were 10 justifications coded as *other* (11.49%) and 7 justifications (8.05%) coded as *uncodable*.

Definitional Task

Description

In this task, the students were asked for their personal definitions of knowledge, information, and truth. In the instructions we emphasized that the definition students provided should be their own, rather than something they had memorized. They were asked: "We want to know how YOU define Knowledge, Information, and Truth. In other words, what do Knowledge, Information, and Truth mean to you?" A separate textbox was provided for each of the terms.

Coding

We used a semantically based coding scheme that included word-level analysis of students' definitions of knowledge, information, and truth. For each term, we identified words that recurred in participants' definitions. This was done by listing all of the words that participants used in their definitions, with the exception of articles, prepositions, conjunctions, and marker words (e.g., "something"). Then, data were inspected for the number of occurrences of each word. We determined that any word appearing in at least 5% the definitions for one of the given terms would be included in further analysis.

Beliefs Across Context and Domain

Last, students' beliefs about whether relations among knowledge, information, and truth would hold for different contexts or domains were assessed. First, participants were asked to explain whether they think their description of the relations among the terms is the same or different no matter where you are (e.g., at home or at school). Then, participants were asked to explain whether what they described is the same or different for any school subject (e.g., social studies or math).

Responses about whether these beliefs hold across context were coded as (a) similar across context (e.g., "because truth is truth and knowledge and informations are truth no matter where you are"), (b) different across contexts (e.g., "... the sources at home might not be as reliable as the sources of Information at school"), (c) similar and different, (d) unsure or (e) uncodable (e.g., responses left blank or with participants describing their uncertainty). Responses about whether these beliefs hold across domains were coded as: (a) similar across domains (e.g., "It is the same for any school subject because if you be truthful about what Information you know you will be successful in learning"), (b) different across domains (e.g., "In math you are learning facts opposed to social studies where you are learning information, that leads to knowledge"), (c) similar and different, (d) unsure or (e) uncodable (e.g., responses left blank or with participants describing their uncertainty). Two of the authors coded 23.0% of the context responses with

$\kappa = .60$ and 24.1% of the domain responses with $\kappa = .75$. Discrepancies were resolved through discussion to reach a consensus, and the remainder of the explanations were coded independently.

Procedure

Participants completed a demographics questionnaire, the KIT bidirectional conceptualization and justification task, the definitional task, and the context and domain questions. Before completing the KIT bidirectional tasks, participants were given a sample bidirectional item asking them about their understanding of the relation between *trying hard in school* and *learning*, to familiarize students with the graphic interface. All measures were completed online, and participants completed the tasks in the computer lab at their school during regular class time. The students were given the option to listen to a recording of the directions as they completed the tasks. These recorded directions were embedded into the online interface and could be accessed by participants at any time during the study. For questions requiring a written response, students were provided with a textbox with no word limit and were instructed to type their response. Students were given as much time as they needed to complete each task.

RESULTS

The results from this study are organized according to the research questions we aimed to address. In the first question we focused on students' definitions of knowledge, information, and truth, and in the second we considered their beliefs about the relations among the constructs. The third question was included address whether students conceptualize their beliefs as holding across domains and contexts.

Definitions of Knowledge, Information, and Truth

To understand how participants defined knowledge, information, and truth, we conducted a content analysis of the words participants used in their definitions. We examined distinctions across the definitions of knowledge, information, and truth, followed by commonalities across the three terms. The frequencies and percentages of the commonly used words are provided in Table 2.

The content analysis indicated that knowledge was commonly defined with the words *already*, *head*, *information*, *learn*, and *true/truth.* Information was associated with the words *book*, *fact*, *knowledge*, *learn*, and *true/truth.* In contrast, the words frequently used to define truth were *correct*, *fact*, *happen*, *honest*, *information*, *knowledge*, *real*, *right*, and *tell.* While there is some overlap, the variation in the words across the three constructs suggested that participants perceived certain distinctions among knowledge, information, and truth. For example, several of the words used to define truth were minimally present in any of the other definitions. *Correct* and *honest* were only used in defining truth, with each used in 8.05% of truth definitions. *Right* was used in 14.94% of truth definitions, but in only one definition of information and no definitions of knowledge. Similarly, *real* was used in 16.09% of truth definitions, but only once in defining each knowledge and information. In definitions of truth, participants frequently incorporated the word *tell* (16.09%), referring to telling the truth.

TABLE 2
Frequency and Percentage of Individuals' Use of Words to Define Knowledge, Information, and Truth

	Terms defined					
	Knowledge		*Information*		*Truth*	
Words used	f	%	f	%	f	%
Already	11	12.64	1	1.15	1	1.15
Book	1	1.15	8	9.20	1	1.15
Correct	0	0	0	0	7	8.05
Facts	3	3.45	12	13.79	7	8.05
Happen	0	0	2	2.30	8	9.20
Head	6	6.90	0	0	0	0
Honest	0	0	0	0	7	8.05
Information	19	21.84	N/A	N/A	13	14.94
Knowledge	N/A	N/A	27	31.03	11	12.64
Learn	14	16.09	23	26.44	0	0
Real	1	1.15	1	1.15	14	16.09
Right	0	0	1	1.15	13	14.94
Tell	0	0	4	4.60	14	16.09
Think	8	9.20	3	3.45	2	2.30
True/truth	6	6.90	14	16.09	N/A	N/A

When it came to definitions of information and knowledge, *tell* appeared in 4.60% of the definitions, referring to information as something that is told to the individual, and not in any definitions of knowledge. In contrast, *learn* was used in definitions of knowledge (16.09%) and information (26.44%), but not in definitions of truth. Knowledge was also characterized by *already* (12.64%) and *head* (6.90%), terms that did not appear frequently in other definitions. *Already* was commonly used by participants to describe knowledge as what they "already know," suggesting that they believe knowledge resides internally. One participant defined knowledge as, "[it's] already in your head and you can pull it out anytime to use it." On the other hand, 9.20% of information definitions included the word *book* (e.g., "something you get from a book, website or person"), a term that appeared in only 1.15% of knowledge and truth definitions, indicating that they regard information as external to themselves.

We noted that knowledge, information, and truth were commonly associated with the definitions of the other terms. *Knowledge* was used in 31.03% of information definitions and 12.64% of truth definitions; *information* was used in 21.84% of knowledge definitions and 14.94% of truth definitions; and *truth/true* was used in 6.90% of knowledge definitions and 16.09% of information definitions. Such cross-consideration of terms indicates that participants regarded these concepts as related.

Conceptualizations of Relations

Knowledge and Information

When discussing the relation between knowledge and information, a substantial portion of participants fell into the *information leads to knowledge* ($n = 22$; 25.29%) and *knowledge leads to*

TABLE 3
Frequency and Percentage of Categorical Classification of Participants' Beliefs About the Relations Among Knowledge, Information, and Truth

	f	%
Knowledge and information		
Separate	3	3.45
Completely overlapping	5	5.75
Partially overlapping	13	14.94
Some information is knowledge	5	5.75
Information leads to knowledge	22	25.29
Knowledge leads to information	18	20.69
Importance/amount	6	6.90
Information is something you know	6	6.90
Other	4	4.60
Uncodable	5	5.75
Knowledge and truth		
Separate	10	11.49
Completely overlapping	12	13.79
Partially overlapping	8	9.20
Some knowledge is true	15	17.24
Knowledge leads to truth	12	13.79
Truth leads to knowledge	12	13.79
Other	10	11.49
Uncodable	8	9.20
Information and truth		
Separate	6	6.90
Completely overlapping	16	18.39
Partially overlapping	9	10.34
Some information is true	22	25.29
Information leads to truth	10	11.49
Truth leads to information	7	8.05
Other	10	11.49
Uncodable	7	8.05

information ($n = 18$; 20.69%) categories. The third largest category was the partially overlapping category with 13 individuals (14.94%). Five (5.75%) individuals described information and knowledge as completely overlapping, and three (3.45%) described the terms as completely separate. Five (5.75%) conveyed that *only some information is knowledge*. Moreover, 6.90% ($n = 6$) of individuals discussed the relative importance or amount, and 6.90% ($n = 6$) described information as something that is known. See Table 3 for a breakdown of the frequencies per category.

Knowledge and Truth

Beliefs about the relations between knowledge and truth were divided somewhat evenly across the six possible categories. The highest number of participants fell into the *some knowledge is true* category ($n = 15$; 17.24%). An almost equal proportion of individuals described knowledge and

truth as completely separate ($n = 10$; 11.49%) or as completely overlapping ($n = 12$; 13.79%), and only eight described them as partially overlapping (9.20%). Approximately one quarter of individuals included a procedural justification, with 12 participants (13.79%) in the *knowledge leads to truth* category and 12 participants (13.79%) in the *truth leads to knowledge* category. See Table 3 for a complete breakdown of the frequencies and percentages for each category.

Information and Truth

The most popular category depicting the relation among information and truth was the *some information is true* category, with 25.29% of justifications ($n = 22$). There were 16 justifications (18.39%) coded as completely overlapping, 9 coded as partially overlapping (10.34%), and 6 coded as separate (6.90%). In the procedural categories, more individuals depicted information leading to truth ($n = 10$; 11.49%) than truth leading to information ($n = 7$; 8.05%).

Domain and Context Specificity/Generality

When asked whether their beliefs held across domains, 56 individuals described them as similar across domains (64.37%) and 11 described them as different (12.64%). One individual described them as similar and different and 19 (21.84%) individuals did not provided a response or provided a response that could not be coded. Of the 87 participants, 57 individuals (65.52%) described their beliefs about knowledge, information, and truth as similar across contexts, 13 described them as different across contexts (14.94%), two individuals described their beliefs as both similar and different (2.30%), and 11 (12.64%) individuals did not provide a response or provided a response that could not be coded. The results suggest that students tend to regard their beliefs as stable across domains and contexts.

DISCUSSION

Conclusions and Implications

In the present study, we aimed to add to the current literature (a) by investigating beliefs about information and truth in addition to knowledge and (b) by examining these beliefs in an understudied population: upper elementary school and middle school students. Using graphical and justification tasks, we also addressed whether students think that their beliefs about knowledge, information, and truth are consistent or change across varying contexts and domains. Furthermore, we aimed to understand the words individuals used to define knowledge, information, and truth, and to identify the types of relations among these terms that were salient for students. Although the types of relations that students articulated in the present study do not directly align with the dimensions identified in conceptualizations of epistemic beliefs as multidimensional (Mason, 2000; Ricco et al., 2010; Schommer, 1990), beliefs about knowledge, information, and truth were described in the present study as having a variety of characteristics. Specifically, within the current study, the degree of overlap, presence of a procedural relation between constructs, and use of one construct to modify another were salient for elementary and middle school students' descriptions of the relations among knowledge, information, and truth.

While several studies have indicated that epistemic beliefs can be recognized and measured in elementary school and middle school students (e.g., Metz, 2011; Ricco et al., 2010; Yang & Tsai, 2010), results from the present study provide additional support for developmental models by identifying that students as young as 5th grade can articulate their beliefs about these complex cognitive constructs. Moreover, in addition to prior research that examined beliefs about knowledge, this study was the first of which we are aware to include beliefs about knowledge, information, and truth, as well as beliefs about their relations in this population. The variety of student responses and our ability to consistently and reliably categorize such beliefs provides support for the use of these tasks to assess the beliefs of students at the upper-elementary school and middle school levels. It is worth noting that in light of the number of categories identified, some participant responses about the relations among knowledge and information, knowledge and truth, and information and truth were coded as *uncodable.* These responses included participants who left the response blank or provided responses such as "that's the way it is." In addition, some participants produced a justification that did not align with any of the other definitions or categories identified or did not provide sufficient description to be coded (e.g., knowledge and truth: "because you think before you tell someone"). Of the participants with uncodable responses, one participant had three uncodable relations, six participants had two uncodable relations, and five participants had one uncodable relation. This suggests that most participants were able to articulate justifications of the relations among these constructs, with only 7.7% of the total bidirectional relations coded as *uncodable.* Given the small number of participants meeting this criteria and the variety in their responses to the other questions, no patterns were identified among the participants with two or more uncodable relations.

Across the justification tasks and definitional tasks, results from this study revealed that students tend to think about knowledge, information, and truth as interrelated. In their definitions, students tended to use these terms to define each of the other terms, with a particularly high instance of using *knowledge* and *information* to define the corresponding term. This is consistent with arguments about the difficulties associated with separating the constructs of knowledge and information (Kettinger & Li, 2010; Lankshear, 2003). For educators seeking to aid their students in developing integrated conceptual understanding, the evidence that students often confound these terms suggests a need to approach learning in a way that more explicitly teases them apart. When depicting pairwise relations among terms, students infrequently described the terms as separate. However, the types of relations that students described differed among the terms. For example, similar to a previous study with undergraduates (Alexander et al., 2012), the elementary and middle school students frequently described procedural relations among terms, although this was most evident for the relation between knowledge and information. These students often described the use of their prior knowledge to access or find information, or the role of information in forming knowledge. Overall, we regard it as encouraging that a substantial proportion of students reported that knowledge and information are related in a procedural fashion (e.g., "information leads to knowledge"). Yet, there is no way to ascertain from this study whether these students enact this process.

For students in this study, truth seemed to be perceived differently than knowledge and information, and differently in certain ways from the beliefs expressed by undergraduates (Alexander et al., 2012). While truth was described by some students as procedurally related to knowledge or information, truth was more often depicted as a modifier of knowledge and information. Students tended to focus on the degree of overlap of truth with knowledge and information. To this end, we

found that most students depicted truth as partially overlapping with knowledge or information, or indicated that not all knowledge or information is true. This suggests that students may be thinking about the nature of knowledge or information in ways that are similar to theories of epistemic beliefs that examine the certainty of knowledge as a dimension of epistemic beliefs (Baxter Magolda, 2004; Perry, 1970). This also aligns with concerns that truth needs to be reconsidered in relation to knowledge and information (Lankshear et al., 2000), and provides educators with a means to discuss the justifications and verifications required for truth establishment. In their justifications and definitions of truth, we identified students using truth in the context of "telling the truth" or "not lying." This theme, identified within elementary and middle school students, was not observed in a sample of undergraduates (Alexander et al., 2012). While it is not unexpected for students in elementary and middle school to think about truth in a rule following or social justice sense (e.g., Smetana, 2006; Turiel, 2006), whether and how they regard "telling the truth" to come into play in academic settings or whether they believe sources online tell them the truth is not yet understood. Future research may benefit from directing participants to think about truth within these settings or tasks to better capture beliefs about truth as they apply to academic learning.

This study also provided insights into whether students regard their beliefs as holding across contexts and domains. For domain and context, approximately 65% of students indicated that they believed that their depiction of the relations among knowledge, information, and truth would be similar. While both domain-specific and domain-general beliefs have been identified in recent epistemic beliefs research (Muis et al., 2006), the present study indicates that when information and truth are included in addition knowledge, there may be overarching beliefs about knowledge, information, and truth that were salient for participants. While this study provides insight into students' self-perceptions of the generality of their beliefs, it is not clear whether the students' understanding that their beliefs are consistent would hold if they were asked to complete the same set of tasks keeping in mind different contexts or domains.

For students noting domain or context differences, they cited a variety of reasons ranging from varying practices across domains (e.g., "social studies is learning about the past and math is doing quizzes") and the type of learning that happens in varying contexts (e.g., "... at Home you are not learning the same things you are learning at school"). When comparing home and school contexts, students reported differences in the typical and preferred sources of knowledge, information, and truth (e.g., "at school true information comes from books and teachers. At home it is from television, books and parents"), and indicated that the sources of knowledge and information may vary in reliability across contexts. Given established practices of domains to vary in what constitutes knowledge verification (Buehl & Alexander, 2005; Muis et al., 2006) and the benefit of adapting standards of verification appropriate to contexts (Maggioni et al., 2010), these findings suggest that students might benefit from support to understand similarities and differences in the nature of knowledge, information, and truth across domains and contexts.

Limitations and Future Directions

In this study, we aimed to deepen the understanding of beliefs about knowledge, information, and truth in students at a critical juncture in their educational development. This initial foray into these beliefs includes limitations that serve as points of consideration for future research. For example, in this study, we captured beliefs at one point in time with a single sample of elementary

and middle school students. This begets questions such as whether the categories of beliefs identified in this study are consistent across other samples, as well as how and whether these beliefs change with age or academic experience. The present exploratory study was not designed to address whether differences in beliefs were due to differences in cognitive development, or whether there were developmental differences in beliefs. Given that participants were grouped in mixed-grade classes according to ability rather than age, differences could not be identified as maturation or academic experience, a contention that has faced research on epistemic beliefs (Greene et al., 2008; Hofer & Pintrich, 1997). Moreover, the large number of categories necessary to capture the nuance of students' beliefs would require a substantially larger sample. As the purpose of this exploratory study was to uncover the nature of beliefs for students within a particular developmental range, late elementary school to middle school, this was a necessary delimitation. Future studies should examine developmental changes and differences in students' beliefs about knowledge, information, and truth, and should include cognitive measures to allow for differences in cognitive development to be teased apart from differences in age or year of education. Furthermore, as participants in this study provided more consensus regarding beliefs about knowledge and information and less regarding knowledge and truth, examining whether certain combinations of beliefs develop earlier than others could shed light on these findings.

Certain strengths and weaknesses with the methodology are also worthy of consideration. For one, the graphical and justification tasks involved innovative prompting of students' beliefs, providing a developmentally appropriate task to gain insight to abstract constructs. However, while participants provided rich depictions and descriptions of their beliefs for most questions, responses to questions of whether beliefs are stable across contexts and domains were not codable for a number of participants. This was largely due to participants providing a response of "yes" or "no" to the question of whether beliefs are the same or different (domain: $n = 7$; context: $n = 5$). Given that these data were not included in the analysis, they were unable to be interpreted in the present study. Future research should examine additional measures of beliefs about the generality or specificity of beliefs. In addition, the examination of whether students' beliefs manifest differently across domains, rather than whether students regard their beliefs as differing, is a next step for consideration. The presence of general beliefs as well as domain- and context-specific beliefs about knowledge, information, and truth is potentially facilitative for students who are required to adapt to a variety of contexts and domains throughout their educational experience.

Although experts and theorists often compare knowledge, information, and truth in terms of whether they are individual/internal or social/external in derivation and substantiation, the task we created to explore children's beliefs did not lend itself to unearthing such distinctions. It is not surprising, therefore, that the children in this study did not spontaneously describe the constructs in individualistic or social terms nor, consequently, provide sufficient explanations for their justifications to be distinguished along such an individual-to-social continuum. Future research can more directly probe students' beliefs about the individual versus societal nature of knowledge, information, and truth to allow for more direct comparisons between participants as well as across constructs.

As one participant aptly noted, "Truth is what is hard to know." While as a field we may not be searching for "truth," we do recognize the challenge of investigating students' beliefs, and contend that knowledge on this topic is an effortful endeavor. Yet, given the importance of students' beliefs in learning and motivation (Buehl & Alexander, 2005; Chen, 2012; Pieschl

et al., 2008), and students' conceptions of knowledge, information, and truth as related to one another, it seems there is a need for further investigations of knowledge alongside information and truth. With the potential insight that such beliefs provide into the minds of students living in this information-saturated world, we hope that more researchers are encouraged undertake this venture.

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