Elementary-School and Middle-School Students’ Conceptions of Knowledge, Information, and Truth

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Abstract

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 (Lankshear, 2003). This study 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 domains and contexts. 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:* knowledge, information, truth, epistemic beliefs
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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), there are certain challenges posed by these contexts. Presenting students in these contexts 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 (Authors, xxxx), 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.

Literature Overview

As evidence of the critical nature of knowledge, information, and truth for students today, recently developed curricular materials, such as the Common Core State Standards in the United States (Common Core State Standards Initiative [CCSS], 2010) have used these terms to characterize learning goals. The CCSS emphasize that students should be able to “integrate information” in history, “provide an accurate summary of the text distinct from prior knowledge” in science, evaluate the validity of reasoning in texts, and “explore the truth of their conjectures” in math. While it would appear that such terms 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). Studies of epistemic beliefs have examined students’ beliefs such as the origin of knowledge, the evidence necessary to substantiate knowledge, and the degree to which knowing is an effortful endeavor (Greene, Azevedo, & Torney-Purga, 2008; Hofer, 2004; Schommer, 1990). Research has consistently demonstrated that these 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 et al., 2011; Hofer, 2004). Moreover, epistemic beliefs have been identified as a critical factor in learning, and have been implicated in students’ text comprehension (Bråten, Britt, Strømsø, & Rouet, 2011; Ferguson & Bråten, 2013), use of learning strategies (Pieschl, Stahl, & Bromme, 2008), and eye movements during reading (Kammerer & Gerjets, 2012). Moreover, students’ epistemic beliefs have 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 theories differ in their explanation of the nature of these developmental changes. For instance, Perry’s (1970) seminal research with undergraduates categorized individual’s epistemic beliefs according to six stages, progressing from least to most advanced. Similarly, Schommer’s (1990) model proposes four dimensions of beliefs, and identifies the nature of beliefs as more or less sophisticated. Models by Baxter Magolda (2004), King and Kirchner (2004), Kuhn and colleagues (Kuhn, 1991; Kuhn, Cheney, & Weinstock, 2000), and Greene, Azevedo, and Torney-Purta (2008) also describe developmental changes in individuals’ beliefs. These models propose that individuals’ beliefs about the complexity of knowledge, the effort required to know, and the types of justifications that are necessary for knowledge to hold develop across the lifespan and throughout schooling.

**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. Lankshear and colleagues (Lankshear, 2003; Lankshear, Peters, & Knobel, 2000) highlight the importance of information and truth for today’s learners, and examine the relation that these constructs have to knowledge, particularly for students working within online contexts, suggesting that it is no longer sufficient to only consider students’ beliefs about knowledge. Further, Lankshear, Peters, and Knobel (2000) point to the need to consider students’ beliefs about knowledge and information not only separately, but also in relation to one another. This comes from scholarship indicating that on the Internet, knowledge and information are often
highly intertwined and difficult to separate, and that all knowledge and information on the Internet must be evaluated relative to whether or not they constitute truth. 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. Moreover, investigating beliefs about information and truth as well as knowledge allows for an understanding of these beliefs in isolation as well as in conjunction.

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 instance, 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 suggests 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). In contrast, truth typically is discussed in terms of its relation to knowledge and information, 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.

A recent investigation of undergraduate students’ beliefs about knowledge, information, and truth (Authors, xxxx) is the only study we are aware of 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 Authors (xxxx) 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 current investigation builds directly on this study in order to examine beliefs about knowledge, information, and truth in children and early adolescents. Due to 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, empirical research in this area has focused primarily on undergraduates and to some extent high school students. The decades of research since Perry’s (1970) initial investigations with Harvard undergraduate students have retained this emphasis, with limited research examining beliefs in younger learners. Despite limited investigations, theoretical and empirical research suggests the importance of understanding epistemic beliefs in children and adolescents before they reach high school. Piaget’s 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; Piaget, 1929/1951). Recent studies 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. A study of first-graders’ reasoning, while designing their own scientific experiments, indicated that even at this young age, many students are nonetheless able to articulate their beliefs about the nature of knowledge (Metz, 2011). 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). These studies have found that students’ epistemic beliefs relate 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;
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Elder, 2002), particularly when compared to 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, such as 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). Further, in contrast to 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). These studies indicate that while
epistemic beliefs can be assessed in young populations, varied measures should be utilized to capture the range of beliefs that young students espouse.

**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. Initial conceptualizations examined beliefs in a domain-general format, with developmental theories positing a general progression of epistemic beliefs across age and academic experience (Hofer & Pintrich, 1997; Greene et al., 2008). 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). On the one hand, 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). 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), and the nature of justifications that they deem appropriate across domains (Hofer, 2000). 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
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(i.e., algorithmically-based) or ill-structured (i.e., heuristic-based; Buehl & Alexander, 2005; Muis et al., 2006). Accordingly, the present study used 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 instance, 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 the present study does not explicitly address whether elementary- and middle-school students hold different configurations of beliefs in different domains, it examines whether context and domain differences evidenced in prior research on epistemic beliefs are represented in the beliefs held by students when reporting their understandings.

The Present Study

In this study, we built on prior research in four significant ways. First, we sought 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, and particularly for students at the critical juncture surrounding the move from primary to secondary education, 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 to devise tasks that allowed students to visually and verbally construct representations and justifications of their beliefs in a structured progression of tasks. Finally, building on epistemic beliefs research, this study examined the stability of students’ beliefs across contexts and domains. The following three research questions were addressed:

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 (Authors, xxxx), 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 these 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 overlap from non-overlapping to completely overlapping. After selecting a graphic that students regarded as
representing their understanding of the relation among knowledge and beliefs, they were asked to justify their selection and explain why it best represented the relation among the constructs. Such tasks were designed to allow students greater freedom in their depictions, providing a structured task, but allowing for open-ended responses. The combination of graphical and written tasks afforded participants the opportunity to depict their beliefs in different ways suitable for their developmental level and allowed for a concrete and accessible representation of the abstract constructs of knowledge, information, and truth to young students.

Methods

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 and participants included 59 males, 27 females, and one student who chose not to report their gender. 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 5th to 9th 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.
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 to 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 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 in order to engage participants in the task. This procedure was repeated for the relation among knowledge and truth, and for information and truth. Participants were first provided with the graphics task asking them to justify their understandings of the relation between knowledge and information as it was thought that these two constructs would be most familiar to students.
Coding. The graphics and justifications were used in conjunction in order to categorize individuals’ beliefs, given that any graphic could be explained in multiple ways. We independently coded responses based on 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. We coded 42.5% of the knowledge and information relations with 75.7% perfect agreement (κ=.73), 23.0% of the knowledge and truth relations with 80.0% perfect agreement (κ=.78), and 47.1% of the information and truth definitions with 75.6% perfect agreement (κ=.73). Any disagreements were resolved through discussion and 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.

Knowledge and information. Based on participants’ graphical selections and justifications, we identified eight categories to describe their beliefs about the relations among information and knowledge, which can be described in terms of the general types of relations depicted. Four of the categories described the degree of relation between the constructs: (a) separate, (b) completely overlapping, (c) partially overlapping, (d) some information is knowledge; two categories described a procedural relation: (e) information leads to knowledge, and (f) knowledge leads to information; one described (g) importance/amount; and the final category described (h) information as something you know.

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. 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. The next category described the terms as nested,
with some information as knowledge, noting that only some of the available knowledge is
information. 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”). 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 instance, one participant noted, “you need to learn information so it becomes
knowledge in your head.” Further, 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; 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 among knowledge and truth. Similar to the knowledge and information justifications,
there were several categories that described 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. The partially overlapping category depicted knowledge and truth as similar in some ways and different in others, and the some knowledge is true category included justifications that described some knowledge as true and some knowledge as not true. 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 in order to obtain knowledge (truth leads to knowledge). In the knowledge leads to truth category were 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 as other and eight justifications coded as 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. There were 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 depicting a procedural relation: (e) information leads to truth and (f) truth leads to information.

Justifications in the separate category described knowledge and information as unrelated, whereas justifications in the completely overlapping category described the terms as the same, or
noted that all information is true. In the partially overlapping category were justifications that depicted the terms as similar or almost the same. Other justifications focused on information as not always truthful, and were categorized in the only some information is true category. In terms of procedural relations, justifications that described information as a necessary condition for getting the truth or for telling the truth were classified in the information leads to truth category. For instance, one participant suggested that “information leads to people knowing the [truth].” Conversely, justifications were classified as truth leads to information if they described 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 seven 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. The instructions 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 employed 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, the 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**

Finally, the 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 80.0% perfect agreement ($\kappa=.60$) and 24.1% of the domain responses with 87.5% perfect agreement ($\kappa=.75$). Discrepancies were resolved through discussion 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. Prior to 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 graphics 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 sought to address. The first question focused on students’ definitions of knowledge, information, and truth, and the second considered their beliefs about the relations among the constructs. The third question addressed 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
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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 between knowledge, information, and truth. For instance, 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.

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
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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.

It was 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 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 among knowledge and truth were divided somewhat evenly across the eight possible categories. The highest number of participants fell into the some knowledge is true category (17.24%). An almost equal proportion of individuals described knowledge and truth as completely separate (11.49%) or as completely overlapping (13.79%), and only a few less described them as partially overlapping (8.05%).
Approximately one-quarter of individuals included a procedural justification, with 13.79% in the knowledge leads to truth category and 10.34% in the truth leads to knowledge category. See Table 2 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. There were 18.39% of justifications coded as completely overlapping, 10.34% coded as partially overlapping, and 6.90% coded as separate. In the procedural categories, more individuals depicted information leading to truth (11.49%) than truth leading to information (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 provide 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 contexts, which counters current research identifying domain-specific beliefs (Muis et al., 2006) and contextual variants in beliefs (Hammer & Elby, 2002).
Discussion and Conclusion

The present study aimed to add to the current literature by investigating beliefs about information and truth in addition to knowledge, and to examine 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. Further, we sought 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.

While there have been several studies to document that epistemic beliefs can be identified and measured in elementary-school and middle-school students (e.g., Metz, 2011; Ricco et al., 2010), the present study provides additional support that students as young as elementary-school can articulate their beliefs about 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 examine 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 and middle-school levels.

Across the justification tasks and definitional tasks, 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 Lankshear’s (2003) argument about the difficulties associated with separating the constructs of knowledge and information for students saturated in an online world. When depicting pairwise
relations among terms, students infrequently described the terms as separate. However, the types of relations that students used to describe the relations among terms did differ. For instance, similar to a previous study with undergraduates (Authors, xxxx), 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 in order to access or find information, or the role of information in forming knowledge. We find it hopeful that a large number of students envisioned knowledge and information to be related in a procedural fashion, however, whether the students actively engage in this process during academic tasks is unknown. That the students in the sample were not consistent in the direction of the relation between knowledge and information was hardly surprising given the on-going debates within the information science and knowledge management literatures as to whether information leads to knowledge or vice versa.

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 (Authors, xxxx). 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 between truth and knowledge and information. To this end, we found that most students depicted truth as partially overlapping with knowledge or information, or indicating that not all knowledge or information is true. 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 (Authors, xxxx). 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.

This study also provided insights into whether students regard their beliefs as holding across contexts and domains. For both 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. With recent research in epistemic beliefs identifying both domain-specific and domain-general beliefs (Muis et al., 2006), the present study suggests that 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”) to differences in the source 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”).

In this study, we sought 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 instance, this study 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 is consistent across other samples, as well as how and whether
these beliefs change with age or academic experience. Although 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. Future research should examine additional measures of
beliefs about the generality or specificity of beliefs, and investigate whether understandings of
the context and domain specificity and generality of beliefs change with age.

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 to further investigations of knowledge alongside of 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.
References


Authors (xxxx)


