Exploring University Students' Perceived Values of Knowledge and Critical Thinking Using Triple-response mode Assessment

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Living in a post-truth era, we face a plethora of misinformation and difficulty finding the truth. The desire for truth in knowledge seeking could contribute to an individual's critical thinking that is directed to maximize the probability of reaching a conclusion that would bring him or her closer to the truth (Halpern, 2003). The present study took an interest in the connection between perceived value of knowledge and proficiency in critical thinking among 199 university undergraduates. We administered the Scale of Perceived Epistemic Value and examined critical thinking ability using Halpern Critical Thinking Assessment (short-form; HCTA; Halpern, 2007), and participants' reasoning of a hypothetical social issue using an essay task. The HCTA captures response of critical thinking in a dual-mode; forced-choice and an open-ended solution, whereas the essay task allows more elaborated and in-depth reasoning to be captured. Together a triple response-mode assessment of critical thinking was used to allow triangulation of results. Educational implications are discussed.

Keywords: epistemic values, critical thinking, values of knowledge, higher education, assessment

INTRODUCTION

In the post-truth era, false and specious information abounds. Objective facts are superseded by emotions and personal beliefs when individuals form representations of the world. Thus, seeking the truth is a difficult task. In philosophical epistemology, knowledge is often seen as intrinsically desirable because it brings us to the truth. The truth is powerful for it serves as a rational guide to our actions and thoughts. Then, actions and thoughts base on rationality is important because they exhibit reliability with support of justification in the real world. However, in everyday lives, individuals' perceived value of knowledge (or epistemic value) often varies. Why is knowledge desirable? This question may yield many answers given individual differences in socio-cultural background, education, motivation, goal, and other factors. Do learners nowadays value the truth in knowledge acquisition? The desire for truth in knowledge seeking could contribute to an individual's critical thinking that is directed to maximize the probability of reaching a conclusion that would bring him or her closer to the truth (Halpern, 2003). This speculated connection between perceived epistemic value and proficiency in critical thinking warrants attention in empirical research.

We examined two research questions. 1) To what extent do university students value knowledge as a means to truth? 2) Is there a linkage between an individual's perceived epistemic value and how he or she reasons critically? We recruited 199 undergraduate participants. We administered the Scale of Perceived Epistemic Value and examined critical thinking on two levels; first, participants' overall

critical thinking ability using Halpern Critical Thinking Assessment (short-form; HCTA; Halpern, 2007), and participants' reasoning of a hypothetical social issue using an essay task. The HCTA captures response of critical thinking in a dual-mode; forced-choice and an open-ended solutions, whereas the essay task allows more elaborated and in-depth reasoning to be captured. Together a triple response-mode assessment of critical thinking was used to allow triangulation of results. Instructional implications with regard to our findings are discussed.

Theory of knowledge and value of the truth

Epistemology is generally taken as the theory of knowledge. What interest epistemologists is the nature and form of knowledge. Essentially, epistemologists ask, "What constitutes as knowledge?" In the simplest terms, knowledge is justified truth beliefs, and that it is powerful only if it depicts beliefs that correctly represent the world as what they are intended to represent. According to the Norm of Correctness, a true belief is one that is repeatedly justified to correctly match with what it intends to represent in the reality, whereas a false belief is one that is defective or is not governed by evidence (Vahid, 2006; Wedgwood, 2002). Philosophers have generally held the consensus that the underlying sole determinant of intellectual value of any piece of knowledge lies in its truthfulness (Goldman & Olsson, 2009).

Yet in everyday thinking, we do hold beliefs for other non-epistemic reasons, in spite of their truthfulness. As Goldman (1999) has put, that "our interest in information has two sources, curiosity and practical concerns (p.3)." This notion leads to individual differences in perceived epistemic value because each of us could have slightly different concerns about information depending on what is of interest and importance to us. People acquire knowledge to satisfy numerous desires in life. There is an association between "what we know and the capacity for getting what we want" (Kvanvig, 2003, p.2). Our desire to learn about how the universe operates might have come from our natural intellectual curiosity, and the desire to pursue a university degree in astrology might have also risen because of the connection between education level, social status, and/or potential earning power. In some cases, the intrinsic curiosity we have for inquiry could come secondary to more practical concerns in life. The perceived importance to desire what is true and avoid what is false is therefore likely to vary among individuals. It then can be reasonably argued that the more or less value for truth seeking a person holds might affect him or her actual action of truth seeking, such as how one would reason to draw conclusion critically.

Epistemic value and critical thinking

Logic is the rules of reasoning, whereas critical thinking is the application of these rules in daily life (Facione, Facione, Giancarlo, 2000). Our "daily life" is a problem context where the correctness of conclusions is often calculated in terms of probability, or likelihood, instead of in absolute black and white terms. This notion is captured in Halpern's (2003) definition of critical thinking – "Critical thinking is the use of those cognitive skills or strategies that increase the probability of a desirable outcome" (p.6). We rely on justification as the mean to evaluate the probability of a belief being true or false. In the process of critical thinking, we ask, "What is the justification for believing that X is true?" Let's illustrate with an example: say Andy believed that tomorrow it would rain. It so happened that the next day was indeed a rainy day. Andy then further predicted that the day after would also rain. And somehow the day after was also a rainy day. Therefore, Andy's beliefs were both true and reliably true (example adapted from Cogan, 1998). However, on what evidence did Andy make the proposition that tomorrow and the day after will rain? Andy was in fact ignorant. Being repeatedly correct in Andy's case is due to pure accident, or luck. To rely our actions, thoughts, and decision making on accidentally true beliefs is like relying on fortune telling. Justification is important in critical thinking, because it is what separates rationality and superstition.

A critical thinker is someone who would pay attention to "evidential foundations" of any proposition (Perkins, Jay, & Tishman, 1993, p. 8) with a clear purpose to use justification to guide his or her beliefs and actions. Justification is a process of seeking evidence to reduce uncertainty. It is a process that requires the thinker to be skeptical, reflective, and tolerant for ambiguity (Halpern, Stephenson, & Williams, 2009). Thinking skills such as weighing evidence from multiple sources, questioning imbedded assumptions, evaluating casual claims, and detecting biases and fallacies are central to justification (Beyer 2001; Halpern 2003). Essentially, these generic skills of thinking allow us "to use objective rules of reasoning to evaluate subjective opinions, and these skills are applicable to different domains of thinking such as making decision, arriving at a judgment, scientific reasoning, and solving problem" (Ku, Lai, & Hau, 2014).

Previous research has demonstrated a close linkage between good thinking outcome and reliance on evidence in reasoning. In a study of Ku et al. (2014), students experimentally prompted to pay attention to the views of authority used fewer evidence and considered fewer evidence from the opposing standpoints. A concern for justification is indeed shared across disciplines. For instance, the medicine and healthcare professions have been advocating evidence-based practice to nurture a concern for truth and an urge for unbiased medical judgment (e.g., Bientzle, Cress, & Kimmerle, 2014; Roex, & Degryse, 2007; Yılmaz& Kaya, 2010). Same goes to the science domain, where students' perception of epistemic relativism and its relationship to beliefs toward science are emphasized in advancing scientific knowledge (e.g., Lising & Elby, 2005; Nussbaum, Sinatra, & Poliquin, 2008; Stathopoulou & Vosniadou, 2007). However, research available on students' value for truth is very limited. Few studies examined a truth-seeking disposition of critical thinkers as characterized by a concern for evidence and an urge to be objective and fair-minded in reasoning. These studies (e.g., Ip et al., 2000; McBride et al., 2002b; Tiwari et al., 2003) found that university students' generally scored low on such inclination. Ku and colleagues (2010) developed the Concern for Truth Scale to capture one's tendency to be alert to misinformation and an emphasis on objective justification in order to arrive at the fairest and most truth-based judgment. A low concern for truth is reflected in judgments based on preconceptions, self interest, authority view, or majority opinion. Among all other dispositions, such as openness to ideas and conscientiousness, the researchers found that only the concerned about truth significantly predicted Chinese students' critical thinking performance. Those who exhibited a tendency to look for answers or solutions from prior beliefs, authorities or outside agents was associated with poorer critical thinking performance, whereas inclinations to engage in independent reasoning based on evidence were related to superior critical thinking performance. In addition to looking at generic disposition towards truth seeking, there is a clear research gap in the literature of critical thinking on whether knowledge is being valued as true belief that is justified and how this could relate to better or poorer critical thinking.

Present Study

The present study examined the connection between perceived value of knowledge and proficiency in critical thinking among university undergraduates. We examined two research questions: 1) To what extend do university students' perceive the value of knowledge as truth seeking as reflected in their ratings on the Scale of Perceived Value of Knowledge? 2) Is there a correlation between university students' perceived value of
knowledge and their performance on critical thinking tasks?

For the first question, we constructed an 8-item Scale of Perceived Value of Knowledge. We first assessed the scale reliability in a pilot phase using a sample of 136 undergraduate students. Eight items were retained and administered to a group of 199 undergraduate participants independent than those of the pilot phase.

For the second question, we predicted that a high inclination to value knowledge for pursuit of truth is related to concern for justification and evidence in critical thinking. There were 199 undergraduate participants. Participants' ability to reason critically was assessed using two tests with altogether three response mode. First, the short-form Halpern Critical Thinking Assessment (HCTA; Halpern, 2007) featuring 10 dual-response items was used to measure students' generic critical thinking ability in five domains, including argument analysis, hypothesis testing, decision making and problem solving, verbal reasoning, and skills in probability. Second, an essay task describing a hypothetical social policy was administered to measure additional sub-skills in argument analysis. The use of triple-response mode assessment of critical thinking allowed triangulation of results and better captured individual differences in underlying rationales.

The results provided insights into whether university students value knowledge for the reason that it leads to truthful understanding of subjects; in what ways individual differences in perceived epistemic value relate to their understanding of what knowledge is like; and how they make use of knowledge to reason critically. These insights provided practical guidelines for educators to create a critical thinking pedagogy and reflected on the need to promote the pursuit of truth in higher education (Schraw, 2001).

METHOD

Participants

Participants were 199 Chinese undergraduate students (74 men and 125 women). They were recruited at three comprehensive universities in Hong Kong through campus-wide advertising. The mean age of the participants was 20.94 years (SD = 1.34; range = 18 – 26). Ethical approval was obtained from the respective Institutional Review Board, and written informed consent was obtained from all participants. In the end of the study, the participants received a debriefing sheet explaining the purposes of the study, and the measures used. All participants received token of appreciation equivalent to US$8 for their participation.

Procedures

Participants completed the Perceived Epistemic Value Scale, the HCTA (short-form), and an essay task in a one-and-a-half-hour group session that took place in a regular university classroom. All measures were administered in paper-and-pencil format. Participants first fill out the Perceived Epistemic Value scale. To control for order effect, half of the participants were instructed to first work on the argumentation task, followed by the HCTA, and vice versa.

Measures

The Perceived Epistemic Value Scale

The 8-item scale (see Table 1) was constructed to assess an individual's perceived value of knowledge as leading to a complete and truthful understanding of an issue. Examples of items are: "Knowledge is desirable primarily because it helps me to distinguish truth and false", "I find it worthwhile to seek justified beliefs even if they do not lead to personal achievement". Participants were asked to rate on a five-point Likert scale (i.e. "Strongly agree" to "Strongly disagree") for each item. A high rating reflected a prominent concern for seeking justification to eliminate falsehood and to gain true belief. A low rating reflected how a belief comes to be justified is unimportant or irrelevant to the perceived value of knowledge.

The construction of this scale began with an initial pool of 12 items based on related discussions of epistemic goals of knowledge in the regime of philosophical studies of epistemology (see Baehr, 2012;

Riggs, 2002; Vahid, 2006). Preliminary analysis for item selection was conducted using a separate group of university undergraduates (N = 136; aged from 18 to 23) recruited. All participants completed the 12-item scale of epistemic value in a 10-minute group session. Participation was voluntary with informed consent obtained. No monetary compensation was given. Problematic items were eliminated and items with ambiguous wordings were modified for validity checks until internal consistency reached a satisfactory level.

A total of 8 items (See Table 1) were retained for use for the current study. The Cronbach's alphas was 0.63.

Table 1
Items of the perceived epistemic value scale

Item	Content
1	"Knowledge is desirable primarily because it helps us to distinguish truth and false"
2	"Knowledge is desirable primarily because it helps to attain our desires in life (reverse coded)"
3	"The intellectual value of a piece of knowledge is determined by how strong its justification is and how accurately it represents the reality"
4	"The instrumental value of a piece of knowledge is just as important as correct representation about things (reverse coded)"
5	"The ultimate reason to acquiring knowledge is the discovery of truths and the elimination of falsehoods"
6	"It is intrinsically rewarding to me when I identify faulty beliefs"
7	"A belief that is uphold by many people must be valuable (reverse coded)"
8	"I find it worthwhile to seek justified beliefs even if they do not lead to personal achievement"

Table 2
Item-analysis of the perceived epistemic value test (Pilot Phase; N = 136)

Item total Statistics	Scale Mean If Item Deleted	Scale Variance If Item Deleted	Corrected Item Total Correlation	Cronbach's Alpha If Item Deleted
Item 1	25.61	11.66	.44	.58
Item 2	26.42	11.28	.32	.60
Item 3	25.51	12.05	.30	.61
Item 4	25.43	12.04	.30	.61
Item 5	25.46	11.02	.28	.62
Item 6	25.31	12.46	.34	.60
Item 7	25.99	10.97	.34	.60
Item 8	25.73	10.86	.37	.59
	Cronbach's Alpha		Standardized Item Alpha	
Reliability Coefficient for Item 8	.63		.65	

Halpern Critical Thinking Assessment (short-form)

Participants' general critical thinking ability was assessed using the short form of the Halpern Critical Thinking Assessment (HCTA; Halpern, 2007). The permission to use the HCTA in Chinese, which was previously translated by the author (Ku et al, 2014a), was obtained from the German Test Company, Schuhfried, for research purpose. The instrument denotes a multi-response format test of domain-generic critical thinking. It contains 25 problem scenarios, each followed by questions asking

for open-ended and forced-choice responses. 10 items were used for the current study given they were statistically revealed as items of better discriminative power that returned a reasonable fit as a single-factor scale in a previous study (Ku et al, 2014a). These items tapped on critical thinking skills including argument analysis, hypothesis testing, verbal reasoning, understanding probability, and decision-making.

Essay task of critical thinking

Researchers have noted that students may exhibit critical thinking skills and abilities in one context, or domain, but fail to do so in another (Willingham, 2007), therefore an additional essay task was used to triangulate findings. Participants were asked to respond to a hypothetical scenario that described a government election system favouring those who are wealthy and intelligent (see Appendix A). The scenario argues that rich people make more contribution to the society as they are paying more tax than the poor, therefore should be entitled to more than one vote in the election; whereas people who receive higher education are more capable in choosing a suitable political leader than those who are less educated, thus should also be entitled to more than one vote. This scenario was selected and adapted from Ku and colleagues (2010). The author revised the level of difficulty and elaborated the content of the scenario to suit undergraduate participants.

FINDINGS

Perceived Epistemic Value Scale

The mean rating of the Perceived Epistemic Value Scale was 3.62 (SD = 0.46). Table 3 reported confirmatory factor analysis (CFA) results for the one factor model of the Perceived Epistemic Value Scale (see Figure 1). Table 3 summarizes the goodness-of-fit indexes for the model. The ratio of chi-square to degrees of freedom indicates a good fit but the NFI is slightly below 0.90 score required for a well-fitting model. All CFI, GFI and AGFI are above the 0.90 score required for evidence of good fit. The root-mean-square error of approximation is below the 0.06 score considered evidence of good fit. This suggests that the one factor model is a satisfactory representation of the underlying structure of the instrument.

Table 3
Goodness-of-fit indexes of one factor model for the perceived epistemic value scale (*n* = 199)

Model	χ^2 (*df*)	χ^2 / *df*	NFI	CFI	GFI	AGFI	RMSEA
One factor	25.872 (16)	1.617	.876	.945	.969	.931	.056

Note. χ^2 has an insignificant ρ value ($\rho > 0.05$).

Critical thinking performance

The possible range of score of the HCTA was 0 - 90, with the mean score obtained = 68.15 (SD = 7.31; Min = 50.09, Max = 86.09.) The cronbach's alpha for the HCTA was 0.81.

Participants' performance of the critical thinking essay task was scored by two trained independent raters using a scoring rubric developed based on Ku and colleagues (2014). The rubric assessed four major components of argumentation; these include 1) strength of argument, 2) strength of reason, 3) strength of counter-reason, and 4) identification of (false) assumption. The possible range of critical thinking subskills was 0 – 3; with which "0" represents an absence of a component, "1" represents a partial delivering of a component, and "2" and "3" represent a satisfactory and a strong delivering of a component, respectively.

For the coding of critical thinking essay task, we recruited two postgraduate students of Education whom were not informed of the purposes of the current study. A training of 2 hours was provided for the raters to get familiarize with the scoring rubric and to practice their coding using some hypothetical scripts. Inter-rater percent agreement calculated was 85%. A summary of the scores was presented in Table 4.

Table 4
Summary of critical thinking performance

	Mean	SD
Critical Thinking Essay Task		
Strength of Argument	2.37	.72
Strength of Reason	1.84	.42
Strength of Counter-Reason	1.62	.61
Identification of (false) Assumption	1.21	.75
HCTA short-form	68.15	7.31

Note. CI = confidence interval.

Correlations

Perceived Epistemic Value was positively related to the score of HCTA ($r = .19$, $p = .03$), and Strength of Counter-reason ($r = .20$, $p = .00$), Identification of (false) Assumption ($r = .22$, $p = .00$), and Strength of Argument ($r = .18$, $p = .03$) in the critical thinking essay task (see Table 5).

Table 5
Intercorrelations between all assessment variables

	1	2	3	4	5	6
1. Perceived Epistemic Value Scale	-					
2. Critical Thinking Performance (HCTA)	.19*	-				
3. Strength of Argument	.18*	.23**	-			
4. Strength of Counter-Reason	.20**	.20**	.28**	-		
5. Strength of Reason	.02	. 14*	.07	.09	-	
6. Identification of (false) Assumption	.22**	.14*	.24**	.13	.08	-

Note. ** $p <.01$ * $p <.05$.

Among the four critical thinking components coded in the critical thinking essay task, strength of argument was positively related to strength of counter-reason ($r = .28$, $p = .00$) and assumption ($r = .24$, $p = .00$).

CONCLUSION, DISCUSSION AND SUGGESTIONS

In knowledge acquisition, aiming at the truth is "of special importance" (David, 2001, p.151), because there is no rationality to desiring faulty beliefs that lead to false representation of the world. In the post-truth era in which we are living, our representation of the world is muddled by a morass of untrue information. Individuals tend to base their opinions and judgments more on personal beliefs and emotions than objective facts. Thus, there are strong barriers to truth-finding. The present study took an interest in the connection between perceived value of knowledge and proficiency in critical thinking among university undergraduates. We examined two research questions: 1) To what extend do

university students' perceive the value of knowledge as truth seeking as reflected in their ratings on the Scale of Perceived Value of Knowledge? And 2) Is there a correlation between university students' perceived value of knowledge and their performance on critical thinking tasks? Critical thinking items allowing forced-choice response, open-ended response, and essay-response in more than one context were utilized. Participants' critical thinking proficiency were assessed using a generic critical thinking test that examining five sets of generic critical thinking skills, and an essay task that examined the exercise of critical thinking under a given ill-structured hypothetical social scenario.

Our findings suggested university participants were positively inclined to value knowledge as leading to distinguishing truthfulness. Those who shown more inclination tend to be stronger critical thinkers as assessed by a generic critical thinking test as well as an essay task illustrating a hypothetical controversial social issue. Though the relationships were statistically significant, the strength between perceiving knowledge as pursuing true beliefs and critical thinking is moderate suggesting other factors might be at play in reflecting good thinking. We speculated that domain specific knowledge, motivation, and existing or prior beliefs related to the topics assessed could be some of the factors not captured by current study.

Specifically, our findings further suggested that students' generic critical thinking as measured by the HCTA (short-form) was of moderate high, and of comparable level with findings from previous study of undergraduate students utilizing the same instrument (e.g., Ku et al, 2014a). Although utilizing everyday scenarios as problem context, the HCTA is considered to be a structured assessment where correct solutions to the problem can be identified. For instance, participants could be asked to give their view on an advertisement that claims adolescents who perceive themselves as lonely are more likely to be overweight. It therefore suggested for these adolescents to join social-skill training program in order for them to maintain a healthier weight. This question examines whether a test-taker recognizes the distinction between correlation and cause and effect. However, reasoning and justification underlying more complex and controversial problems cannot be tapped. We therefore adopted an essay task to examine university students' reasoning in an argumentative passage, as well as their ability to defend their own arguments. The essay task asks for opinion on a hypothetical scenario that described a government election system favouring those who are wealthy and intelligent (see Appendix A). Students performed moderately well in offering both opinion and counter-opinions with justification. Their performance was however the weakest in spotting imbedded assumptions and evaluating their truthfulness. An assumption is an unexamined belief. If an assumption is true, it enable us to claim that a particular reason does indeed provide support for a conclusion. Assumptions are often hidden and thus during the process of thinking critically must be teased out for explicit discussion, challenge, or deliberate consideration. People then often base their conclusions and inferences on assumptions about which they have not critically thought. For instance, most participants were able to point out that the surface-level assumption of those who received more education tend to be wiser voters was more likely to be untrue. Or that "those of higher income contribute more to the society" is equally untrue because not all contributions come in monetary terms. The participants were able to spell out the criteria they used to examine the truthfulness of an assumption, for example, those with higher education could vote blindly, engage in bribery and corruptions in the election, or to vote for political leader who would benefit their own social group. Underneath the assumption of "who received more education tend to be wiser voters" is the imbedded assumptions underlying the right to vote – an assumption reflecting a utilitarianism view would say that effective general elections are the ones where capable leaders are elected, whereas an assumption reflecting liberalism would say that the right to vote is a form of basic human rights. This level of assumption, which represented conflicting worldviews, was only mentioned by a few participants. Those who were able to identify assumptions that reflect such conflicting worldviews underlying the reasoning of how we should consider the right to vote were better able to generate counter-reason, leading to a more in-depth perspective in viewing

the problem. This piece of findings highlighted that critical thinking requires a careful attention to assumptions because they are the hidden basis of our reasoning that bring us closer to the truth.

Current findings pointed to three important implications in terms of teaching and learning in higher education. First, misinformation brought by the post-truth era challenges everyone and renders knowing what to believe and what not to difficult, thereby speaking to the significance of inculcating a habit of pursuing the truth in students. To approach information critically with truth as an aim, effort at higher education other than digital literacy is needed. To think like a critical thinker, students need to move beyond simple fact checking to desiring and valuing justifications over mere opinions. Second, our findings highlighted the need to facilitate analysis of imbedded assumptions of opinions and arguments and helping students to be sensitive to the characteristics of assumptions and the roles assumptions play in everyday reasoning. There needs to be more elements in higher education instruction that go beyond attainment of factual knowledge but considering the truthfulness of assumptions with different implications when knowledge is applied in everyday lives to solve real-life problems. Third, the current work underscored the importance of nurturing critical thinking as we emphasize the intrinsic value of attaining knowledge for justified true beliefs in university students. The perceived epistemic value for truthfulness highlights, in terms, the dangerous of falsehood. University students nowadays are social media "native", who naturally rely on social media for information (e.g., Brandtzaeg, & Chaparro-Domínguez, 2020). Social media provides people a plethora of information and a platform for the rapid dissemination of such information (Doerr, Fouz, & Friedrich, 2012). Online information, however, is not undoubtedly credible. Misinformation on social media is not uncommon and it often includes false claims, inaccurate report of information, and fabricated information (Popat, Mukherjee, Strötgen, & Weikum, 2017). Thus, the prevalence of social media has propelled the spread of unreliable, if not dangerous, socially destabilizing information, amplifying fake content and falsehoods (e.g., Waszak, Kasprzycka-Waszak, & Kubanek, 2018). Our work has highlighted the importance of fostering sensitivity to and motivation to debunk falsehoods of the young generation, thus speaking to the importance of the adoption of these elements in higher education.

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