

Assessing students' higher order thinking using epistemic cognition : A call for better epistemic matching between pedagogic aims and outcomes

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Iwate University's Faculty of Humanities and Social Sciences "aims to nurture individuals who can...understand from a comprehensive viewpoint the problems of contemporary society" (Iwate University, n.d.). These problems have been characterised as being ill-structured in that they "possess multiple solutions and uncertainty about which concepts, rules, and principles are necessary for the solution" of the problem (Reed, 2016, p.691). A critical presupposition inherent in the aim of developing students with the requisite abilities in ill-structured problem solving is the notion that students have reflective awareness of problem types and how knowledge can be structured differently to address each problem type. Yet, studies in epistemic cognition have repeatedly demonstrated that this presupposition is problematic (Baxter Magolda, 2006; Hofer, 2016; King & Kitchener, 2004). Rather, students typically progress through a naïve to sophisticated sequence of changing beliefs regarding the nature of knowledge and their relationship to knowledge (Greene, Sandoval, & Bråten, 2016), a sequence that needs to be more fully understood if successful pedagogic interventions are to be created that realise the faculty's goals. This paper describes an assessment of this faculty's students' epistemic beliefs in an attempt to present a valid starting point for continued discussions into how best to develop students' higher order thinking.

Epistemic cognition is the field of inquiry in psychology that studies the beliefs about knowledge and knowing in individuals (Hofer, 2016). Hofer's (2016) list of three questions about epistemic cognition summarises both the nature of the study and the implications for educators:

"What is knowledge? How do we know what we know? What influence might this set of beliefs have on how we think, reason, and learn?" (Hofer, 2016, p.19) .

The first question points to the philosophical investigation into epistemology, and epistemic cognition frequently return to philosophical notions in the quest to refine the core construct (Chinn, Buckland, & Samarapungavan, 2011; Kitchener, 2011). However rather than look outside the individual into abstracted philosophical notions, epistemic cognition recognises that each individual holds *folk beliefs* (Hofer, 2016), a set of more-or-less reflective beliefs about the nature of knowledge and how knowledge operates. These sets of folk beliefs had been labelled *personal epistemology* in the earlier studies, echoing the notion that every individual has their own personal theories about knowledge, irrespective of their education in the philosophical tradition of epistemology. In the second question, the initial *how* points

to the method of receiving or developing knowledge and to the mechanics of how that knowledge is used by the individual. It is the third question that is of direct interest to educators: the corollary of educators having a better understanding of students' epistemic cognition is the development of more focussed pedagogic systems (Bråten, 2016). The subtext of this paper is the argument that the Faculty's aim can be achieved more effectively with a fuller understanding of the state of students' epistemic cognition. This paper represents an attempt to provide such an understanding and introduces the notion of the *epistemic ladder* to provide a framework for educators to assess both their own and their students' epistemic levels.

Since Perry and his colleagues' (Perry, 1970; Perry, Sprinthall, Wideman, & Jones, 1968) seminal work with middle- and upper-class white American males, many other frameworks have been developed. Perry (1970) describes nine stages of epistemic cognition, ranging from absolutist thinkers who conceive their world in terms of right-and-wrong, information emanating from authority and being separate from the knower to fully contextual knowers who recognise both the intrapersonal nature of knowledge generation and the situational aims of knowledge. To counter the whiteness, classness and maleness of Perry, Belenky *et al.* (Belenky, Clinchy, Goldberger, & Tarule, 1986) studied the intellectual development of women. Largely, they concur with Perry in both the nature of development and of how the stages are characterised. However, they add a preliminary stage of *silence* not present in Perry. To Belenky *et al.* prior to realising that women have a voice at all, some women are *silent* in that their knowledge and ways of knowing are merely mirrors of that in their menfolk. Just as with the relationship between Perry (1970) and Belenky *et al.* (1986), the major frameworks of epistemic cognition overlap significantly, indicating a set of stable underlying constructs in individuals' relationship with their knowledge and their knowing. The common cores include the initial dichotomy of *knowledge-from-outside* the individual to *personal-knowledge* (c.f. Polanyi, 1962) and the increased development of self-reflexive abilities (indeed, King & Kitchener, 1994 called their framework the *Reflective Judgment Model*). This paper, however, draws upon Baxter Magolda's (1992) framework of personal epistemology. That will be described next with reference to the roles of individual learners and of educationalists.

Baxter Magolda's (1992) longitudinal phenomenology distinguished four stages. The first, *Absolute*, sees the world in black and white terms. Knowledge is handed down to students by teachers, textbooks and others in authority. The student's role is to understand and memorise this information. Such knowledge from authority is seen as being unconditionally right, with the knower unreflexively and passively accepting these as truth judgments. Knowledge that is not necessary for the students' life (particularly in relation to tests) is not important to the student. Absolute knowers ignore what they perceive as trivial information, and such information is not drawn upon in decision making.

Transitional thinkers at the second level can include non-important, that is, irrelevant, information in their assessment of their world, but to them, there is still a right and a wrong way of seeing the world. Those at the transitional stage view the 'wrong' information from teachers and textbooks as a way for students to figure out why the right way is in fact the

right way. Other information is wrong, but transitional thinkers believe that teachers present irrelevant information to students so the student can learn how to spot the differences between right and wrong.

At the third, *independent*, the knower level no longer expects a right and wrong way to look at the world. They understand and accept the fact that there are many opinions and that these different ways of knowing are right. Everyone is entitled to think as they think is good. The independent student's role is to learn about all of the possible opinions. Baxter Magolda (1992) reports that many students feel a great sense of freedom as an independent thinker. The truth of the world is no longer something handed down by adults, and students are able to see many truths and find one for themselves. The student's role is to learn the rationale behind multiple opinions, and the corresponding role of the teacher/textbook is to provide access to those opinions while supporting the learner's understanding of them.

The final level is the *contextual* stage. Until this stage, truth is seen as something outside of the individual. However, contextual thinkers realise that knowing an absolute truth is impossible; all truth is understood as being contingent on how others know other things. They become aware of the progress of knowledge building and of human agency: that humans have shaped their world according to their beliefs, and this shaping has shaped our world. Contextual thinkers understand that truth needs to be justified, to be argued for, to be understood in context. Truth exists, but this truth is based on many other truths which can only be known in their context. The contexts may include the reasons for the choice of theoretical lens used in the creation of the new knowledge, and the notion of a *personal* knowledge becomes intractably associated with existing bodies of knowledge. At this level, truth is something that is a combination of outside influences and personal reactions. Individuals' life histories, their experiences of good and bad, their understanding of how truth emerges from information and so on affect how they feel their sense of knowledge. Knowing involves personal reflection, and knowing includes this reflection on judgement. The contextual student's task is to justify their truth. At this stage, the notions of personal knowledge and justification become instrumental in how the individual shapes their own meaning. Teachers and textbooks lose their centrality to be replaced by the growing importance of the support and mentorship role that teachers can provide.

The brief description above contains the implication that if the educational delivery method does not complement the stage needs of the student, the epistemic mismatch negatively influences academic outcome. O'Siochru and Norton (2014) introduce the notion of *epistemic match* to refer to "the level of compatibility between student beliefs and those presented beliefs" by the instructor (p.398). They discover a significant correlation between academic performance and the epistemic level of instructional content. The importance of the epistemic match gathers further support in Dai and Cromley (2014) whose study finds that chemistry undergraduates' academic achievement is higher when their epistemic beliefs are matched by appropriate instructional models. Logically, prior to deciding on educational delivery methods (e.g. content-based lecture model, student-centred debate, group problem-based learning, and so on) and at which epistemic level such deliveries need to be pitched, the initial task is to investigate the student body in order to assess and evaluate their

epistemic cognition.

Much remains unknown about how individuals alter their epistemic belief system, but it is argued that the primary change mechanism is epistemic doubt (Bendixen & Rule, 2004; Ferguson, Bråten, & Strømsø, 2012). Epistemic doubt refers to the sense of confusion that arises when individuals “questions the existence of absolute knowledge” (Chan, Ho, & Ku, 2011, p.74). Ferguson and Bråten (2013) argue that the discovery of resolution strategies in the face of epistemic doubt while dealing with conflicting information sources may be a viable “impetus for epistemic change” (p.51). How epistemic match is usefully co-ordinated with epistemic doubt and then influences epistemic change remains in need of research.

Methodology

Participants

In order to provide such an understanding, an investigation was conducted with a third-year academic English writing class. This research site was selected for a number of reasons. As academic writing is partially rhetorical, partially argumentative, and partially persuasive in nature (McLean, 2010), studying how students understand their own thinking is an ethical use of class time. Also, the class helps students in third year prepare for writing their fourth year graduation thesis, making this age group particularly useful for estimating the epistemic level of the graduation thesis and the epistemic cognitive level of the student group themselves. In this view, these students represent the summation of the Faculty’s educational delivery which can be used to test the degree success of the Faculty’s mission statement.

Method

Eleven students attended a ninety-minute lecture/discussion class on the topic of epistemic cognition as a part of their normal fifteen-week course. One participant’s data was removed from the analysis on the basis that they had fundamentally misunderstood the class. The course utilised a blended instructional approach (Roblyer, 2015) in which a physical class was supplemented by an online discussion session on a secure Internet forum board. Following the physical class, students posted an initial response about the class on the forum board and then posted at least two follow-up responses to other students in an extended online discussion. Students were expected to provide a self-assessment of their epistemic cognitive stage using Baxter Magolda’s (1992) framework. Three participants did not attend the lecture and only read the lecture handout prior to posting on the forum board.

Participants were advised that their written output would be used for this study and were given the opportunity to withdraw without penalty. No identifiable information about any participant is included.

Data was analysed using a direct realist approach which presupposes that participants’ “accounts constitute accurate descriptions” of their worldview and a critical realist approach that allows for an interpretation of the source data in order to find patterns of meaning

to emerge (Willig, 2013, p.69). This approach also assumes that participants' output is a direct representation of their intentions. Criticisms of this approach include the claim that because students wrote in their second language (L2) and, because of linguistic interference from their L1, the *real* meanings cannot be assumed (e.g. Kubota, 2014; Li, 2014). A strong version of the L1/L2 interference question claims that all cross-linguistic communication is suspect; while a weaker version of the claim limits the interference to issues of larger-scale meaning creation; for example, critical thinking abilities (Stapleton, 2002), the creation of the writer's voice (Matsuda, 2001), academic writing structures (Kaplan, 1966) and so on. The source data in this analysis does not include written examples longer than a paragraph, and the assumption in this paper is that participants' L2 is sufficiently expert enough for them to convey the propositional meaning of their epistemic cognition. Those places in the data where linguistic issues made the text uncertain were eliminated from the analysis.

Template analysis is consistent with a direct and a critical realist approach (Brooks, McCluskey, Turley, & King, 2015). A template of themes derived from Baxter Magolda (1992) informed the analysis. The initial themes were the four stages of epistemic development: absolute, transitional, independent and contextual. These themes were supplemented by emergent themes derived from the data. They were teacher role and peer role.

Outcomes

Self-reported levels

Two students categorised themselves as being absolutist thinkers, and one placed herself¹⁾ as having characteristics of both the absolutist and transitional levels. Akari²⁾ describes herself in this way.

I think that I tend to be absolutist but I don't think this way of thinking is so good. It's because I tend to see things through only one way and decide this is true or false, good or bad. In this way of thinking, the answer is clear because the answer is one³⁾

The absolute nature of Akari's thinking is underscored by her insistence on a single, correct answer. Koyuki adds the conceptual difficulty of sifting between what absolute thinkers treat as important or non-important information.

I feel that I am in "Absolutist" as [the teacher] said, and I need to include non-important information for my life in my assessment. Also, I understood that teachers and textbooks show unnecessary information for us to think about why the right way is the right way. However, I can't come up with concrete example of them.

Ai is unsure if she fits the absolute or the transitional category. Her reasoning centres on the difficulty of establishing her opinion in the face of opposing ideas.

I think I am a absolutist or transitional thinker maybe. It's because I still can't think and

1) Non-gendered pronouns are used on principle where gender identification is not necessary.

2) All names are pseudonyms.

3) Except for spelling errors, participants' language is not edited.

develop my thinking or opinion only myself while listening someone's opinion.

All three participants who have self-identified at the absolute level rely on information from authority figures or peers in order to develop their own opinions. Their view of the knowledge generation process is one whose direction is largely from outside. There is little sense of a reflexive judgment with regard to information processing in terms of how information is brought into existing knowledge structures and made personal. However, although all three participants believe that their level of thinking is low, they are aware of their level being a potential issue in their own intellectual development. They perceive a categorical difference between how they think and how others think at a higher level. Akari demonstrates a wish to improve her thinking.

However, almost all things have some faces. So I think that seeing things through some sights is important. I want to have more flexible thinking.

But Akari is not able to differentiate a methodology of attaining better thinking beyond the assertion that it makes thinking 'more flexible'.

Five participants described themselves as being transitional thinkers. Hinano sums up this position eloquently.

I think I am in the phase of transitional. I am able to see two different types of opinions, but they all support only their side, and I prioritize the one which supports my claim. This shows that I choose one-sided opinion which could be right based on my claim.

The transitional thinker is motivated to accept or reject opinions and claims based on their own presuppositions. This creates a dichotomous pattern whereby informational truth value is based on whether the information fits pre-existing beliefs or not, rather than the judgment be based on evidentiary reasoning. Upon receiving information, a transitional thinker looks for attributions that support their notion of validity or non-validity. Daiki exemplifies this mindset.

I still tend to think and decide something it is good or bad... I think my way of thinking is classified as transitional. When I think something, I still think the information is right or wrong.

Ryuichi echoes this point lucidly.

I sometimes see right or wrong when I want to agree or disagree to the opinion.

The conceptual space between transitional and independent thinkers is traversed when the individual no longer is willing to believe in the primacy of their own unreflective judgment. Independent thinkers recognise that their subjective positions have no less, but also no more, validity than the subjective position held by another. The sense that the transitional opinion is right is a remnant of the earlier absolutist position in which all information was either right or wrong. At the independent stage, thinkers reject that certainty. Yuka reflects the importance of recognising other sides in an issue.

Through my life, I might have some experience of making sure of differences between two ways. However, when I think which is right way for me, I also try to consider about other sides of thinking.

I don't know this thinking is completely "Independent" thinker, but I try to do that.

Yuka is accurate in her assessment of the possibility that her way of thinking does not entirely match Baxter Magolda's independent stage. To Yuka, the search for a 'right way for me' still has connotations of transitional thinking. Or conversely, there is the argument that

Yuka is beginning her path towards contextual thinking, in which more definite answers are theoretically possible. However, this argument is weakened due to the lack of evaluatory criteria and reflexive judgment. The need for evaluation between competing truth claims is understood by Miku.

At the independent level, students become appreciate every informations. They compare informations and find these value even there are a information which is not written in textbook. Therefore students who is in independent level can be said that they evaluate imformations well. On the contrary, transitional level students show attitudes toward imformations because just their teacher or textbook tell them so. Students like that cannot be said they evaluate imformations. Thus independent level is more developed than transitional level.

Miku's statements express a good understanding of the differences between transitional and independent thinking. However, it is inconclusive based if she can distinguish between independent and contextual thinking because of her erroneous assertion that independent thinkers 'evaluate informations well'. This evaluatory step is in the domain of the contextual thinker.

No participant who attended the class and completed the forum posting self-identified as a contextual thinker. One participant who only wrote on the forum board did so, but they provided no reasoning for their decision. The question of the accuracy of self-reported levels is discussed later, but at this point the levels are taken at face value.

Emergent themes

Teacher role

Two key themes were identified during the template analysis. The first of these is the role of the teacher. Hinano argued for the possibility that teachers themselves may be at a lower epistemic level.

...teachers' role in the independent and contextual level is to provide opinions to students. If the teacher has a narrow-minded view, then it may not be very effective to the students.

Although it is unclear from the data if Hinano believes that some teachers function at lower epistemic cognitive levels or if teachers deliberately present information at those lower levels, it is clear that teacher narrow-mindedness is an issue perceived by some participants. Yuno offers a pragmatic suggestion based on her experience of narrow-mindedness.

However, in my opinion, if the teacher has a narrow-minded view, students should learn from his or her negative example. I have such a experience.

In this study, Yuno's perspective was not followed up on, but investigating how successful students themselves can learn to flourish in less than optimal learning situations is an avenue for further research in epistemic cognition. One such method is suggested by Koyuki.

I also feel that teacher's view affects students. I feel that what non-important information they give to students may be also important for students to develop in the phase of Absolutist.

Here, 'non-important information' refers to information that absolute or transitional thinkers will likely disregard in their selection of their truths. Yet, Koyuki recognises

the developmental possibilities when learners are required to deal with non-important information. Being exposed to this may induce a sense of epistemic doubt in students' minds.

A distinction in how teachers' roles are perceived may be drawn between the self-reported absolute/transitional thinkers and the independent ones. In the posts of the lower level thinkers, teachers are often written about in conjunction with textbooks as being a way for students to receive knowledge. Mami offers a typical example of this belief.

Knowledge is given to students by teachers or textbooks and students understand the knowledge and distinguish what is wrong and right.

Miku, a self-reported independent thinker, is able to distinguish between the lower position of accepting "informations because just their teacher or textbook tell them" and the need to "evaluate informations", which are often available to Miku when she goes beyond the textbook to research information for herself. No participant discusses the potential role teachers may have in helping students evaluate information, or even if that happens in their experience. This lack may be mutually reinforced by both teachers, in their delivery style, and by students, who, in Yuka's words;

tend to be passive to teachers, so we should think something more active.

This position acquires more urgency in an educational environment in which teachers are perceived to be information providers, not co-constructors of knowledge with students. Ryuichi confirms this position.

The thing which teacher teach us is just the fact especially in Japan.

The importance of peers

If teachers are not perceived to be avenues for further discussion, this cannot be said of peers. Over half of the participants emphasised the importance of peer relationships in their cognitive development. Miku states directly that;

I like to talk with friends about our ways of thinking.

Yuno offers an intriguing glimpse into a question of potential value to educators. She writes that;

...what our friends said can influence our ways of thinking.

The question centres on the peer issue being about access or method; that is, do peers only provide an avenue for discussion that helps individuals develop their own voice, or are peers instrumental in shaping students' cognitions? The data provides limited support for the latter option. Yuka notes that;

In university, we can communicate with so many different types of friends, so we can know much information from their. It makes our thinking more wider.

"Different types" provide different opinions, standpoints and experiences. These are likely to instigate epistemic doubt into students' thinking. The textbook and teacher seem to be sources of right and wrong in participants' belief structures, but the peer offers interpretations of the information source. Such interpretations allow students to realise insights into the deeper and personal nature of what is seen as raw information. Whether or not the insights are instrumental in effecting students' development into a higher stage is not clear from this data. Further research is needed on this point.

Discussion

Accuracy of self-reporting

There remains a question about the accuracy of participants' self-reported levels. Is it really plausible that students can understand their own personal epistemologies in a single combined lecture—forum board discussion week? Are participants liable to over-represent their abilities, or otherwise misrepresent them, when they know that others will read their posts? The field of epistemic cognition now contains a vast literature spanning single- and multi-authored books and thousands of academic articles over the past fifty years (Greene et al., 2016). Commensurate with the vastness of the field, the understandings and the remaining questions present a body of information that cannot be summarised neatly into a single ninety-minute lecture to students, especially those who are not educational psychology majors. In addition to this complexity, much recent work into epistemic cognition adopts the view that rather than be all-or-nothing stages in development, orthogonal dimensions within the overall construct can be distinguished (Hofer, 2016). Investigating the nature of these dimensions, how they interrelate and what other constructs they interact with has been a major focus of recent studies. Yet, the notion that stages do exist continues, and the older terminology, *personal epistemology*, is retained by such theorists. Baxter Magolda's (1992) framework was selected as the basis of this study partially because of the conceptual ease it displays through its use of stage theory. In addition to this apparent simplicity, there is arguably an intuitive sense that younger individuals think differently from older ones, or those who have had an extensive education. This sense is challenged by Chandler, Hallet and Sokol (2002) whose argument relies on children's theory of mind research to claim that primary-aged children also have independent thinking dispositions, albeit only with topics that they are cognitively able to grasp. So the accuracy question can only be limited to a much narrower one about how participants understood and responded to very broad characterisations of a single framework of personal epistemology.

There can be no definitive answer to the question of the accuracy of self-reporting, but I would offer a qualified response. Both the participants' self-reported classification and their reasoning are generally co-ordinated. Where they do not match, the differences between the self-reported stage and where a specialist may place them is no more than one stage. For example, Koyuki identifies herself as an absolute thinker, correctly linking her need to "think about why the right way is the right way" with being typical of an absolutist. Yet, she also adds that;

When I find that there are opposite opinions to others, and I don't know which is right.

Elements of transitional thought can be seen here. Her need for a "right way" prevents the interpretation of her statement as an example of independent thinking; it points, rather, to a confusion of method of evaluation within an untransformed perspective of the existence of a right answer. Similarly, Akari judges herself as an absolute thinker, but she notes that;

Almost all things have some faces

In both cases, an incipient transitional mindset can be identified.

A further difficulty concerning self-reporting is participants' general lack of demonstration of their reflexive abilities. This may be a result of one of two reasons. The first is that the general culture on the forum board did not allow a reflexive stance to emerge. If the researcher had intervened and had asked probing questions that specifically targeted reflexion, such data may have become available. Even so, I feel that this is unlikely in this context because of the second reason. King and Kitchener's (1994) model describes a middle stage thinker as *quasi-reflective*. By this, they refer to individuals who demonstrate the appearance of reflexion without the substance. A prototypical example they provide is:

"People think differently, so they attack the problem differently. Other theories could be as true as my own, but based on different evidence" (King & Kitchener, 1994, p.15) .

Yet, no substantial analysis of what the theories or evidential bases are forthcoming: neither are discussions on how those theories or evidence interact to produce differences. The categorisation of quasi-reflective individuals overlaps significantly with Baxter Magolda's (1992) independent thinker. Both sets lack the ability or insight to provide more details. The highest self-reported data in this study echo King and Kitchener and Baxter Magolda, and the conclusion is that even after probing, no deeper epistemology would be forthcoming. Smiley (2018) asked probing questions to a similar group of participants with similar results.

The ease at which Baxter Magolda's framework was understood by participants occludes its inherent complexity. Much was missed out, or quickly passed over with only a brief comment, in the ninety-minute lecture. For example, following on from Perry (1970), who in turn drew upon Piagetian notions of horizontal decalage (Hofer & Pintrich, 1997), individuals may revert to previous stages' abilities while developing the readiness (or not) for exploration into higher stages. The stage theory approach does not present a cut-and-dried fixed set of beliefs that are applicable to all individuals. Instead, more fluid notions of typical descriptions of stages characterise each stage. It is, therefore, unnecessary to fully commit participants' self-reporting to stages unconditionally. It is enough to accept them as a rough indication of their understanding. The possibility that participants judged themselves higher than their true level is minimal due to the fact that the majority placed themselves in the lower categories. This paper summarises the participants' levels as being predominantly absolutist/transitional with the developmental possibility evident.

Implications for pedagogic delivery methods: The epistemic ladder

Much discussion is given to different ways of delivering pedagogic models to students to increase student engagement with their education (Kahn, 2014). Various methodologies have been proposed and trialled that aim to understand both the nature of learning and the nature of the learner. Bruce, Edwards and Lupton (2006) provide a typical example of how teachers and learners in information literacy may differently characterise their axiomatic values and beliefs about these natures. To these voices, I propose a framework which I call the *epistemic ladder* to address the issue of developing deeper understandings of knowledge and how the self operates in the creation of knowledge. This framework attempts to be appropriate to different pedagogic methods, including the lecture model and constructivist models. In other words, the epistemic ladder is applicable to an information dissemination

style and to discussion classes.

Feucht (2010) describes the concept of an epistemic climate as “the nature of knowledge and knowing in the classroom as emerging from the personal epistemologies of students and their teachers” (p.58). His Educational Model of Personal Epistemology (EMPE) is a framework that includes epistemic instructions, learners' personal epistemologies and epistemic knowledge representations. The EMPE allows educators and researchers to investigate the conditions within which epistemic cognition may be developed. Two critical features are missing from the EMPE: a more finely-tuned set of descriptors that illustrate what different levels of epistemic cognition may be. Such descriptors may be inferred from models such as Baxter Magolda's (1992) ; and methods for instigating epistemic doubt. However, Feucht's (2010) notion of epistemic climate is vital in the university environment if the development of individuals who are able to address ill-structured problem solving is to be taken seriously.

The epistemic ladder (Figure 1) describes an environment in which the number of statements in any opinion-making or truth claim are considered. At the lowest rung of the ladder is a single statement, an opinion-level utterance that has no evidentiary, experiential or other support. There is a misconception amongst participants that the production of an opinion is the *target* of their education. Akari summarises her erstwhile belief that:

I thought that it's a good thing to find much information which support my opinion

displaying a lack of understanding of confirmation bias or other cognitive biases. This *-opinion-as-end-point* belief is common amongst participants. It includes step two: the production of any type of justification to support the opinion. At this point, the justification is described as pseudo-epistemic; that is, the function of justification is to offer any kind of support but not necessarily support that has bases in models or theories of knowledge generation processes. Also, the voice of the other is missing. This appears in step three: the recognition of another's justification. This refers to two aspects. The first is the acceptance of another's point of view. This 'acceptance' is not a simple leap. As discussed earlier, absolute thinkers reject or discard any 'non-important' information. At the opinion level of belief, it is easy to see why the opinions of others may be discarded, and if this mindset is maintained in regard to more complex, scientific debate, how knowledge-generation is impeded. The second is the display of theory of mind, which usually refers to “the ability to attribute mental states to oneself and others” which generally develops in humans around four years of age (Sodian & Kristen, 2016, p.68). Cromer (1995), however, uses the notion of theory of mind in the sense used here: a willingness to include others in decision making. This distinction is useful because it aids an understanding of why absolute thinkers' reasoning is limited. The final step in the lower, non-epistemic, section of the epistemic ladder is the existence of an evaluation between the opinions given. This evaluation is not epistemic in nature, being typically based on personal experience or on plausibility (Smiley, 2018).

A threshold concept blocks entry to the truly epistemic aspects of the ladder. A threshold concept is;

“considered as akin to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, or interpreting, or viewing something

without which the learner cannot progress” (Meyer & Land, 2006, p.1) .

The distinction between opinion giving and truth claim assertion, I argue, is a threshold concept in epistemic cognition. Scientific writing is predicated on assertions of truth that are necessarily located within knowledge generation paradigms that extend beyond the scope of any individual and that have appropriate methods of justification (Bhaskar, 2008; Moses & Knutsen, 2007). Individuals who fail to realise the located nature of knowledge have conceptual difficulty in understanding the difference between available opinions and situated, or contextualised, truth claims. This threshold portal needs to be traversed prior to higher levels of awareness being reached.

Once, the production of an assertion is realised to be a truth claim, replete with available justifications and theoretical backings, the very same opinion in step one can be understood at a higher level, even if the theoretical backing and justification are not given. Steps six, seven and eight mirror those at two, three and four with this critical distinction: because they are grounded in existing theoretical suppositions, they necessarily include references to those theoretical arguments. And in accordance with the epistemic nature of truth claim justification and evaluation, particular paradigmatic and domain-level methodologies of justification and evaluation will necessarily be present. The final step is only partially epistemic and partially personal. The decision to support one truth claim over another can only rest on personal axiomatic beliefs held at the level of individual's values (Moses & Knutsen, 2007). However, the clear difference between a step nine decision and a step one opinion lies the presentation of evidence-based reasoning, competing claim assessment, theoretical grounding and true epistemic evaluation.

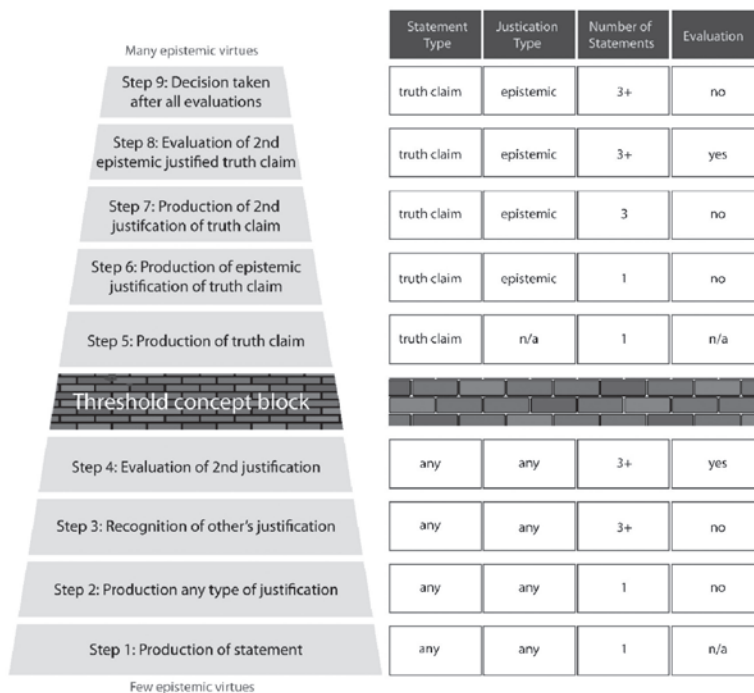


Figure 1: The epistemic ladder

The epistemic ladder is presented here as a framework for teachers to judge efficiently the level of their pedagogic content and the state of students' responses. Teachers can evaluate their lecture content using the ladder's criteria. For example, some lecture material can be seen to consist mainly of statements whose truth value is assumed to be accurate. Such a lecture may be assessed as being at step one. Hopefully, this is rarely the case as at least some justification in the form of evidence should be present. However, in informal discussions with faculty professors, I have found that Steps three and four (or Steps seven and eight) are rare. Information is given with supporting evidence, but counterarguments are not presented, leading to a pedagogic situation where epistemic modelling of evaluatory processes is missing. Professors point to the lack of time and the corresponding amount of material in their field that needs to be covered. This conspires to produce Step one/five and Step two/six style pedagogic delivery methods. In the preceding sentences, I have forgone a full discussion that focusses on the question of the lectures being at Step one or Step five. If the information is delivered with explicit reference to the underlying theory that has formed the basis for the information to be derived, then the likelihood is that the information is at Step five: otherwise it is at Step one. Judging student output is done in a similar fashion.

It is hoped that the epistemic ladder provides a methodology for enabling students to understand and achieve higher levels of epistemic cognition. Participants exhibited a confusion over what they termed "non-important information". Here an important question must be raised; is information ever *unnecessary*? To this, we can also ask *Do teachers ever actually show unnecessary information?* and *Why do students think that some information is unnecessary?* To an absolute thinker, such non-important information is wrong and not worthy of consideration. Yet it exists. To a transitional thinker, it is given to students in order for them to practice distinguishing between truth and fiction. To an independent thinker, there is no non-important information; all opinions are equally valid. A contextual thinker, likewise, does not reject non-important information. However, they are able to view the appropriate theoretical, evaluatory and justification instruments that enable a judgment about the likely value of a truth claim. The epistemic ladder allows information in the form of opinions and truth claims to be placed in regard to its structure in the argument.

Conclusion

At the outset, the faculty's mission statement was noted, which gave rise to an important question about the success of the mission. From this small study, the answer is that the graduating student (based on the presumptions that the graduation thesis broadly mirrors students' epistemic cognitive states and that their state at the end of third year is roughly their graduation state) does not achieve the highest levels of cognitive abilities. Indeed, this study and another (Smiley, 2018) provide evidence that the graduation level is generally at the transitional stage. The faculty's graduating students are unlikely to be able to deal with the complexities of modern ill-structured problem solving.

The reason for the transitional level at graduation may be one of two causes, or, more

likely, a combination of both. The first is that the fifteen-week lecture system typically does not include enough, or any, models of higher level cognition on which students can base their own cognitive development. The second is that undergraduate students end their studies typically at the transition stage (Baxter Magolda, 1992). Figure 2 shows Baxter Magolda's quantitative data from her study. It is only in the fifth year that the independent stage students surpass the number of transitional stage students.

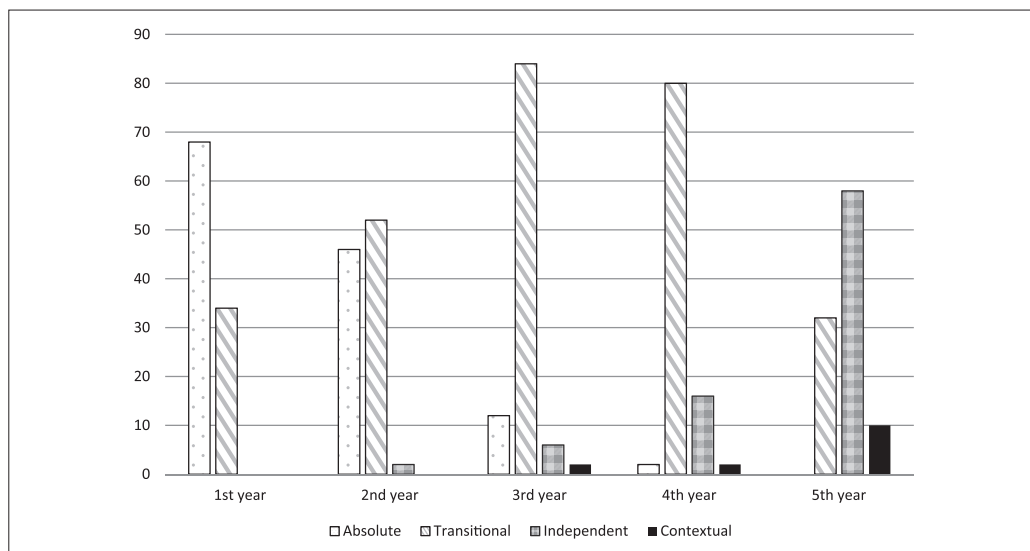


Figure 2: Ways of knowing by year from Baxter Magolda (1992, p.71) .

The teacher's role showed its importance in the development of higher order thinking. Models are required for students to emulate. These models can be provided by professors in their choice of lecture materials and by how the materials are discussed in the class. The simple logical conclusion that arises if professors continue to present domain knowledge at the lowest levels of epistemic thinking; that is, on the lower rungs of the epistemic ladder, students will graduate at those low levels.

But an important consideration goes beyond what input teachers may provide. The importance of the role of peers needs to be noted again. Both inside the classroom and outside of it, the faculty would do well to consider ways to increase student engagement with curricular content. The data points to a genuine interest in peer discussion both inside and outside the classroom, an interest that, if utilised, could aid the development of epistemic cognition in students. Such discussion would allow more demonstrations of epistemic modelling and be avenues in the generation of stage-appropriate discussions amongst peers.

One suggestion for educators is to include epistemic cognition topics directly in the discussions. Epistemic cognition has been studied using phenomenological methodologies, but the methods employed have not used direct questioning of participants' knowledge of their folk epistemologies. Perry (1970) utilised an interview approach in which he asked participants to talk about salient events in their education. King and Kitchener's (1994) method used ill-structured problem solving questions to tap into participants' epistemic

beliefs, a method also used by Kuhn (1990). Much work into epistemic cognition since this first epoch relies on quantitative measurement, but recently Greene and Yu (2014) have called for a return to qualitative studies because of the increasing need to refine the core constructs in light of advances in the field. This paper represents such a response to Greene and Yu. I argue that the result is acceptable because participants displayed an active interest in their own thinking and the supposition that a direct knowledge of Baxter Magolda's framework would be of interest and of benefit to them. This proved to be accurate. The counterclaim that participants would be erroneous in defining their own thinking was also shown to be inaccurate. The direct instruction approach did not produce an instantaneous improvement in participants' stage level. To hope otherwise would have been overly optimistic. However, the seeds of improvement have been planted. Ongoing research is imperative.

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