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The Admiralty Code: A Cognitive Tool for Self-Directed Learning

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Abstract. This article introduces The Admiralty Code – a cognitive tool, used by police investigators and intelligence analysts, which can also assist learners in evaluating information and distinguishing it from potential misinformation or disinformation. One reason for using inquiry-based learning methods in education, is that they develop students' capabilities for engaging in self-directed inquiry, throughout their personal and professional lives. But the carefully-designed information environments in which students conduct inquiry-based learning in schools or colleges are much more benign than the ones in which they will conduct their self-directed inquiries, later on. Information environments such as the internet or the mass media present the inquirer with an excess of information, as well as misinformation and even disinformation. The challenge of distinguishing essential from non-essential information and of evaluating its trustworthiness is not addressed sufficiently by inquiry-based learning methods in benign education environments. Use of The Admiralty Code has the potential to correct this shortcoming. Application of The Admiralty Code is illustrated by an analysis of the evidence surrounding the mysterious loss of HMAS Sydney in 1941.

Keywords: Learning; Inquiry; Evidence; Cognitive Tools

Introduction

Inquiry-based learning methods have been adopted in education for two main reasons: (i) many educators and researchers believe that they help students develop a deeper understanding of conceptual knowledge (Learning Goal 1) than is typically attained via traditional teaching methods (Bransford, Brown & Cocking, 2000; Brown & Palincsar, 1989; Rogoff, 1998; Webb & Palincsar, 1996) and (ii) inquiry-based learning techniques model the norms and methods of inquiry in a profession or discipline and therefore develop students' capabilities for engaging in such inquiry for themselves, throughout their personal lives and professional careers (Learning Goal 2) (Barrows, 1990; Bereiter, 2002a, 2002b; Bereiter & Scardamalia, 2000, 2003; Feltovich, Spiro & Coulson, 1997; Scardamalia & Bereiter, 1996, 2006; Schon, 1983,1987; Wells, 1999, 2000, 2002). Those capabilities are built by mastering the skills in conducting inquiry-related tasks, by developing an understanding of the principles underpinning inquiry and by adopting norms or attitudes that promote critical, but constructive, inquiry.

Inquiry-based learning activities in education are usually structured and guided by more experienced others – teachers, tutors, supervisors, professors – and are focused on questions that are determined in advance and driven by the requirements of a curriculum. Beyond education, however, personal or professional inquiry is more often *self*-directed and focused on questions that arise in an *ad hoc* manner, driven by the inquirer's desire (or perceived need) to know.

Inquiry-based learning techniques in education do help students develop many of the 'cognitive tools' that will be useful for self-directed inquiry beyond education, but perhaps not all.

The information environments of inquiry-based learning in education can differ in important ways from those often encountered by self-directed inquirers beyond education. The main learning objective of inquiry-based learning in education is to help students develop a deeper and more applicable understanding of those theoretical principles which are the main focus of the curriculum. This objective is more likely to be achieved when the information environment is carefully structured and managed to *remove* irrelevant or misleading content and when the students' inquiry is guided (or 'scaffolded') to limit the potential for developing misconceptions or pursuing investigative dead ends. As a result, educators dramatically reduce the need for learners to cope with excess information, misinformation and even disinformation. Yet these are three characteristics of the information environments in which we conduct self-directed inquiry in our personal and professional lives (eg. the internet). Learning how to operate effectively in (mis)information-rich environments is an essential aspect of Learning Goal 2. So, by structuring and simplifying the learning environment to optimise the development of conceptual knowledge (Learning Goal 1), educators may also be impeding or limiting the attainment of Learning Goal 2 – developing students' capabilities for engaging in self-directed inquiry.

The cognitive toolbox developed for students by inquiry-based learning techniques in education may be in need of some additional tools. After explaining the concepts of self-directed inquiry and misinformation-rich environments, this article will introduce The Admiralty Code – a cognitive tool which has proven its effectiveness in professional practice and which would be a valuable addition to the self-directed learner's toolbox.

Self-Directed Learning

Self-directed learning, whether conducted individually or in collaboration with others, is an activity in which "the conceptualisation, design, conduct and evaluation of the learning project are directed by the learner." (Brookfield, 2009) Although humans have presumably been engaging in self-directed learning since time immemorial, the term is now most closely associated, in the English-language literature, with *andragogy* – a model of adult learning articulated by Malcolm Knowles (1970). Although the term has earlier, European uses, Knowles characterised *andragogy* – the art and science of helping adults learn – as being quite distinct from pedagogy – the art & science of helping children learn (Knowles, 1975). Knowles's original model of andragogy proceeds from four assumptions which he used to distinguish adult learners from children:

- the adult learner is more self-directed and less dependent than the child
- the adult learner has a greater reservoir of experience to draw upon as a resource for learning
- the adult learner's readiness (or motivation) to learn is closely related to his or her current social role.
- the adult learner has a more problem-centered orientation to learning, in contrast to the subject-centeredness of pedagogy.

Today, of course, many researchers and educators will recognise self-directedness, problem-centeredness, personal relevance and the importance of prior knowledge as features of some constructivist-inspired approaches to *pedagogy*. Knowles, himself, acknowledged, in later years, that his andragogical principles could be applied to the education of children and pedagogical principles could be applied to adults (Knowles, 1990). Nevertheless, he regarded self-directed learning as the epitome of adult learning and facilitating self-directedness as a key goal of adult education.

Inquiry-Based Learning

Inquiry-based learning, in education, challenges students with questions, problems or scenarios which are intended to motivate learning. The learning is achieved by inquiry, which might include such activities as investigation, experimentation, debate or discussion, to discover or construct answers or solutions. It often culminates with the learner having to present and explain his or her findings to others. The learning, so achieved, may be problem-specific or it may be more general. Inquiry-based learning, in which learners are presented with questions and assisted to discover or construct answers (ie. concepts), is often contrasted with direct instruction, in which learners are presented with concepts directly. In direct instruction, it is the instructor who presents a concept, explains it and elaborates upon its relationships with other previously-presented concepts. The learner learns by observing, listening and, hopefully, thinking about what is being presented. In inquiry-based learning, it is the learner who does the explaining and elaborating and, although this may require more time and more effort from the learner, it forces the learner to think carefully about what is being learned and thus leads to deeper understanding than might be achieved by direct instruction.

One feature that is absolutely crucial to the success of inquiry-based learning methods in education is guidance. All inquiry-based learning methods in education involve guidance: either guidance through a complex information environment by a tutor or teacher or guidance via a simplified information environment which has been carefully designed in advance to lead the student toward the intended 'discovery' (eg. structured learning materials, computer simulations, etc). Inquiry-based learning activities in which students appear to be engaged in self-directed inquiry, without a teacher's supervision, are generally of the latter type in which the guidance has been built into the learning materials. The learning environment is usually designed to make the inquiry task easier by excluding materials which are irrelevant or misleading. The process of inquiry – asking sub-questions, selecting lines of investigation, proposing hypotheses, evaluating information, making decisions, exploring relationships – is also carefully guided, either via instructions or questions in the learning materials which scaffold the inquiry process or by a teacher or tutor who actually participates as a co-inquirer.

A number of inquiry-based learning methods emphasise the role of knowledge elaboration using computer-based cognitive tools, such as mind maps or influence diagrams. This approach makes the process of knowledge construction visible in the form of models or diagrams which are under construction by the learners. They also facilitate collaboration – several learners can work together to build a representation of their shared understanding of an issue as that shared understanding develops. Collaboration, especially if it involves a more knowledgeable teacher or tutor, allows developing misconceptions to be identified and challenged early. As the learners construct these external knowledge representations, they are also constructing their own knowledge internally. The cognitive tools, themselves, can help to guide learners' thinking by focusing their attention of the particular functions of the tools, such as depicting causal directions among concepts.

The last decade has witnessed a debate about the conditions under which inquiry-based learning might be superior or inferior to traditional direct instruction for the development of students' conceptual knowledge (Hmelo-Silver, Duncan & Chinn, 2007; Kirschner, Sweller & Clark, 2006; Kuhn, 2007; Tobias & Duffy, 2009). But inquiry-based learning methods also serve another purpose which is perhaps the main reason for their growing popularity: they teach students how to engage in systematic inquiry. They place students in the guided and supported role of young scientist or young social scientist. The intention is to foster positive attitudes, in students, toward questioning and open inquiry, and to develop their skills in using analytical techniques (comparing hypotheses, designing experiments, collecting and analysing data) and engaging in discourse patterns (debating, offering causal explanations, questioning assumptions, etc.) which, it is hoped, will enable them to engage in systematic inquiry throughout their professional and personal lives (Scardamalia & Bereiter, 2006).

Self-Directed Inquiry in (Mis)Information-Rich Environments

However, engaging in systematic inquiry in one's professional or personal life often does not necessarily mean following the research methods of the natural sciences or even the social sciences. In our personal lives, even those questions that are related to the natural sciences must usually be addressed by means other than controlled experimentation or systematic data collection and analysis.

In societies characterised by division of labor and specialisation, we have to rely heavily on information provided by others.

Learning via self-directed inquiry means conducting an investigation, alone or in collaboration with others, to try to answer a question of personal relevance. The question motivating the inquiry is often related to a professional or personal decision confronting the inquirer, at the time, so finding timely answers or solutions is often a priority. While self-directed inquiry might not be an optimal pedagogical approach for learning curriculum content within an educational institution, there are many important learning situations, in life, for which self-directed inquiry is the only viable option. It may be the only available option within time constraints. It may be the only affordable option.

Questions motivating self-directed inquiry are often expressed in the first person. Some examples are:

1. If I want to gain strength and muscle mass, without harming my health, should I use anabolic steroids or should I not?
2. If I am concerned about climate change, which party's policies should I support?
3. If I want to maximise my lifespan and optimise my health, should I eat foods containing saturated fat or should I not?
4. If I want to lose body fat, which particular combination of diet and exercise will be most effective?
5. If I want to earn a good financial return over the next 10 years, should I invest in residential real estate or should I not?
6. Was the judge's verdict that Oscar Pistorius was not guilty of murder a reasonable verdict? Should I campaign for an appeal or a retrial?

These are the types of personally-relevant questions that motivate learning via self-directed inquiry and learners often begin by searching for relevant information provided by informants whom they believe to be knowledgeable. Today, this process often begins with an internet search. The internet contains an abundance of information relevant to each of the six questions, listed above, and many others. The mass media, too, runs regular stories on each of these topics and many others. What makes these topics media-worthy is that they are personally-relevant to many people and the answers to these questions are hotly debated. On topics such as these, the distinction between information and misinformation is not easily drawn.

Guided, inquiry-based learning, conducted in education contexts, often takes place in benign information environments which have been structured for the purpose of learning. Instructors and educational designers select or design the information resources that learners will encounter during their inquiry to give students the best chance of constructing new knowledge in the form that the teacher intended (ie. 'correct' knowledge). While there may be some cases of misinformation, in which a mistaken educator or textbook author will misinform students, there are unlikely to be many cases of disinformation, in which educators or textbook authors set out deliberately to deceive students.

In contrast, learning via self-directed inquiry often requires learners to engage with information environments that are poorly-structured (for the purpose of learning) and which contain vast resources of information, as well as well-intended, but mistaken, *mis*information and even deliberately-misleading *dis*information. For example, a Google search conducted in Sydney, Australia, at the time of writing, using the search term 'steroids', returned 36,600,000 results. Of the top ten hits, 3 were strongly in favor of using anabolic steroids to build strength and body mass, 4 were opposed to it, and 3 took a balanced approach, listing pros and cons. Two of the pro-steroids results were websites selling steroids online and the third was a discussion forum for people who used, or were interested in using, steroids. Three of the anti-steroids results were news stories in the mass media about individual cases of alleged steroid abuse by three young men and the fourth was a website selling natural alternatives to steroids. One of the balanced results was Wikipedia and the other two were government health information sources. Only one of the top ten hits displayed any results of medical studies of steroid use and it was one of the (pro-steroid) online stores. It used those research results to challenge some anti-steroid claims, made by others, which had purportedly been based on medical research evidence, but which had apparently been exaggerated. The balanced sources listed the potential effects of using steroids but did not indicate the typical consequences of these effects or their probabilities.

The self-directed inquirer is in a quandary. Given their opposing recommendations, these 10 'information' sources on steroids cannot all be correct. A well-educated inquirer might begin to tackle this problem by drawing upon some of the analytical techniques learned in school, college or graduate school. Techniques for using information to inform one's judgments and decisions are examples of cognitive tools.

Cognitive tools

Cognitive tools are constructed objects or learnable techniques designed assist human cognition. They enable us to do more cognitively than we would be able to do without them (Resnick, 1987). A map is a cognitive tool that enables a skilled user to navigate through an unfamiliar landscape. A simple electronic calculator is a cognitive tool that allows us to complete calculations more quickly and with less effort. The technique of long division, learned in elementary schools prior to the advent of the calculator, was also a cognitive tool which enabled students to divide large numbers, using only their knowledge of elementary multiplication tables, up to 10x10. Even scientific theories can be regarded as cognitive tools which enable explanation and, in many cases, prediction. Today, the term 'cognitive tool' is most often associated with computer-based objects & procedures (Jonassen & Reeves, 1996), since a computer allows us to house a great variety of cognitive tools in a single device (eg. apps on a smartphone), but computers are not essential to the concept.

Every profession and human pursuit has its own set of cognitive tools. In a sense, it is skill in using the cognitive tools of one's profession that distinguishes the more skilled professional from the less skilled. Inquiry-based learning methods are, quite properly, modelled on the investigative work of natural scientists and engineers. Learners use some of the cognitive tools used by scientists – influence diagramming, causal model building, hypothesis testing and so on. But the view of the scientific profession, assumed in inquiry-based learning, is a purist's view, unsullied by the possibility of self-interest or financial motivations or political ideology. It is a view in which truth always wins, nature doesn't deceive and, thanks to the scientific method, nor do scientists. Indeed, in education environments, generally, students are supposed to assume that textbook writers don't make mistakes and teachers don't set out to deceive students. Given enough time and sufficient resources, the work of the scientific community probably does eventually converge on the purists' ideal. Hopefully, questions 1-4 listed above, will eventually have clear answers, thanks to the scientific work of health scientists and environmental scientists. Economists and financial analysts express conflicting opinions about question 5, but time & hindsight will eventually answer that question, too.

Meanwhile, however, people are faced with professional and personal decisions of real consequence and those decisions cannot wait for hindsight or for well-established answers from the scientific community. The designers of inquiry-based learning would typically model this challenge as a scientific challenge to be addressed by building a causal model, proposing and testing hypotheses and they would be at least half right. But there is another aspect to this challenge which tends to be ignored by educators. A well-resourced scientist can investigate nature directly via experiment or systematic observation & data collection. The self-directed inquirer can do this, to a limited degree (eg. by trying out different weight-loss diets) but must depend, for the most part, on *informants*. The inquirer, described earlier, will learn about the effects of anabolic steroids from informants in a misinformation-rich environment.

Since the top ten hits on Google present opposing conclusions, some skepticism is clearly in order. But universal skepticism, though it might seem like a safe epistemological position, is utterly useless for practical purposes. Disbelieving everything is no better than believing everything, when there are judgments and decisions to be made.

The first judgments required, here, are judgments about the informants, themselves. This challenge is quite similar to the challenges faced daily by police investigators and intelligence analysts. These two professions, like all professions, have developed or adopted cognitive tools to assist them in their cognitive tasks. Police investigators use evidence, including the claims of informants, to try to explain how a crime was committed and by whom. The police explanation, if persuasive, will become the prosecution's account of how & why the defendant allegedly committed the crime. Intelligence analysts use evidence, including the claims of informants, to assess the risks of future crimes, security breaches or acts of aggression. Their assessments and forecasts, if persuasive, may lead to preventative action by police forces, defense forces or security agencies. Both of these professions face challenging tasks – especially the intelligence analysts, who have to deal with the future – and both work in misinformation-rich environments, where secrecy and deceit are commonplace and where the claims of informants may be motivated by a range of factors: public duty, remorse, greed, fear, loyalty, vengeance, ideology, ego, the desire for special treatment, the cessation of mistreatment, or any combination of these (Fitzgerald, 2006).

This article will now introduce The Admiralty Code – a cognitive tool for evaluating information or evidence which has proven sufficiently useful in these professions to have become part of their standard toolbox of analytical techniques. Use of The Admiralty Code is sufficiently straightforward to be included in inquiry-based education programs without requiring much additional teaching time.

The Admiralty Code: A Cognitive Tool for Evaluating Information or Evidence

The Admiralty Code is a relatively simple scheme for categorising evidence according to its credibility. It was initially used by the British Admiralty for the assessment of evidence used in naval intelligence, but it is now used in many police departments, intelligence agencies and defense-related organisations, including the US Army (US Army Field Manual 2-22.3, 2006)

In trying to answer a question or resolve a controversy, the inquirer will ultimately be trying to build a 'theory' or an explanation that is consistent with all of the *credible* evidence. Before doing so, however, it is important to make judgments about which evidence will need to be explained by the inquirer's theory and which evidence can probably be discarded due to lack of credibility. The Admiralty Code can assist in this task.

The Code prompts the inquirer to rate each piece of evidence according to:

1. The expected reliability of the source in providing accurate information on this occasion (rated from A to F). The source might be a person (eg. the Captain of the *Kormoran*), a publication (ie. *Nature, Wikipedia*), a method of information collection (eg. interrogation of prisoners of war, a death-bed confession, DNA testing), or some other information source. A source's reputation is typically based on its track record of providing accurate information in the past, so one important aspect for assessing the reliability of the source is its reputation. Another important aspect is motivation – why might the information source be providing this information? The other major factor for assessing human witnesses is their competence (proximity to the reported events, fatigue, sensory limitations, potential for unintentional bias, and expertise in correctly interpreting what they claim to have seen or heard).
2. The likely validity of the claim (rated from 1 to 6). How does the claim compare with other evidence that has been shown to be valid? How well does it fit with existing theories/explanations (eg. is it consistent with the laws of physics? Is it consistent with the Australian navy's standard procedures in 1941?)

	Expected Reliability of the Source					
Likely Validity of the Claim	**A1**	B1	C1	D1	E1	F1
	A2	**B2**	C2	D2	E2	F2
	A3	B3	**C3**	D3	E3	F3
	A4	B4	C4	**D4**	E4	F4
	A5	B5	C5	D5	**E5**	F5
	A6	B6	C6	D6	E6	F6

Credible – accept

Uncertain – investigate/wait

Non-credible – reject

Figure 1: The Admiralty Code for evaluating the credibility of evidence

The Code applies a letter (A-F) and a number (1-6) to each piece of evidence to indicate its credibility. At the top end of the diagonal credibility scale, A1 evidence would be a claim, emanating from a highly-reputable source with no plausible ulterior motive, which has also been verified by other means. At the bottom end, E5 evidence would be a claim from a very dubious source which seems inconsistent with other known facts. The letter F indicates a source with unknown reliability and the number 6 indicates a claim whose validity cannot yet be assessed, so F6 evidence should be treated as not yet on the scale. Dealing with evidence along the diagonal is quite straightforward. A1 and B2 evidence would be accepted as credible. D4 and E5 evidence would be rejected as non-credible, with C3 evidence on the borderline. The more difficult judgments are those that lie off the diagonal. E2 evidence would be a plausible claim from a source known to have been untrustworthy in the past. It might be worth looking closely at the source's motive for informing. B5 evidence would be a very surprising claim from a normally-reliable source. This might require caution and open-mindedness until it can be reassessed at a later time, when more information becomes available. A later reassessment might upgrade its likely validity or simply confirm that it was wrong, all along. A few more such errors and our B source might have to be downgraded to a C. The inquirer who uses the Admiralty Code can decide how many cells to color white (credible), how many to color light-gray (uncertain) and how many to color dark-gray (non-credible). Light gray cells often indicate that further investigation is required to try to validate or invalidate this piece of evidence, but this would require additional investigative work and resources, in addition to time, so an inquirer has to make a type of cost-benefit decision when choosing to color a square light-grey. An overly-cautious inquirer might choose to color all cells light-gray, except for A1 and E5. By doing so, this inquirer can be confident of never making an erroneous judgment. But, by doing so, this inquirer will also probably never make a decision.

An illustration: Using The Admiralty Code to investigate the mysterious loss of HMAS Sydney in 1941.

To illustrate the use of these three cognitive tools, the paper will apply them to a major public controversy in Australian military history – the loss of HMAS *Sydney* in 1941. Many of the decisions and judgments faced by self-directed inquirers do not require all three of these analytical techniques – just one, or perhaps two. But the more challenging the information environment becomes, the more useful all three of these techniques can be. This case has been chosen because it shows how all three of these cognitive tools can be used to make reasonable and defensible judgments even in the most misinformation-rich environments – those characterised by a shortage of evidence and a wealth of conspiracy theories.

HMAS *Sydney* was a light cruiser which had an eventful and very successful campaign in the Mediterranean in 1940. While operating with the British Mediterranean fleet, she had, on one occasion, engaged two Italian cruisers and defeated them in a two-on-one gunnery battle, sinking one of the Italian ships and forcing the other to retire. With a glowing reputation now as the best ship in the navy, HMAS *Sydney* returned to Australia in 1941, where she took up patrol and convoy escort duties in the relatively peaceful waters of the Indian Ocean (Gill, 1957). In November 1941, HMAS *Sydney* escorted a troopship, carrying part of the Australian 8th Division, bound for Singapore, where that Division was being posted to try to deter anticipated aggression by Japan. Half way to Singapore, in late-November 1941, HMAS *Sydney* handed over escort duties to another cruiser, as planned, and turned back toward Fremantle, its home port in Western Australia. HMAS *Sydney* was never seen again.

Mysterious disappearances are open invitations to conspiracy theorists and the loss of HMAS *Sydney* was no exception. Might a Japanese submarine have started its war against the allies, 18 days earlier than scheduled, by torpedoing HMAS *Sydney*? Might the Australian & British Governments have concealed their knowledge of this Japanese attack, so as not to interfere with the upcoming attack on Pearl Harbor, which they knew was coming and which they hoped would bring the USA into the war on their side? Conspiracy theories work best, when evidence is lacking or when the available evidence comes from a questionable source. All of the initial evidence regarding *Sydney*'s disappearance came from such a source.

In the days following HMAS *Sydney*'s disappearance, small groups of German sailors were captured, floating in life rafts or washed ashore on the Western Australian coast. They told their captors that they were the crew of the German merchant raider *Kormoran* – a cargo vessel that had been given guns, torpedoes, mines and a German naval crew to prowl distant sea lanes sinking British and allied merchant ships, while disguised as a Dutch merchant ship *Straat Malakka*. The military purpose of German merchant raiders was to tie up British naval resources (McQueen, 2011). If Germany's 10 raiders could create enough havoc for merchant ships in distant parts of the globe and remain at large, they could force the British navy to send valuable naval resources to those far distant parts of the globe where they could not contribute to the main maritime conflict closer to Britain. One German merchant raider, still at large, might tie up 10 or more British and allied warships in convoy and escort duties in the Indian and Pacific Oceans, at a time when they were needed in Europe and the North Atlantic.

The German sailors from *Kormoran*, now prisoners of war, told their interrogators that they had been sailing northward off Western Australia when they saw a warship, directly ahead, steaming southward towards them. Merchant raiders carried torpedoes which could sink a cruiser at close range, but cruisers carried more accurate, longer-range torpedoes, more guns which were accurate at a longer range and they had superior speed and combat systems. Raiders were converted cargo ships which were never designed to fight warships and their strategic purpose was to create and maintain a hazard for merchant ships that would tie up British warships in convoy and patrol work. A raider crew's mission was to remain undiscovered for as long as possible. If they were trapped by an allied warship, they were instructed to scuttle their ship to prevent items of military value from falling into allied hands. Perhaps the most valuable item carried by a raider was its enigma machine, used for encoded communication with other German ships, such as the raider supply ships which would rendezvous secretly with the raiders to replenish their supplies of fuel, food and ammunition. A captured enigma machine would enable the allies to break the German raider fleet's code and mop up the remaining raiders and their supply ships very quickly, freeing up naval resources for the main fight in Europe and the North Atlantic.

Mindful of their mission, the *Kormoran*'s crew tried to evade identification by the approaching warship. They changed course dramatically from due north to southwest, turning their stern towards the warship and positioning themselves between it and the setting sun so that it would be difficult for observers on the warship to see the identifying details of their own ship. When the warship changed course to intercept, the Germans increased speed to try to delay a visual inspection from abeam until after sunset, when identification would be more difficult. After dark, *Kormoran* might even have a chance to escape, since Australian cruisers carried no radar in 1941.

Sydney developed a full head of steam and pursued at high speed, sending persistent requests, via signal lamp, for the unknown ship's name and destination. After delaying for some time, the Germans eventually replied by signal flags, but hoisted them deliberately in a position where they were obstructed by a mast and difficult to see. The setting sun, behind those signal flags, would have ensured that they were quite unreadable from the bridge of *Sydney*. After a long pursuit, *Sydney*'s great speed brought her alongside the unknown ship before the sun had set and *Kormoran*'s options were running out. But *Kormoran*'s captain saw one last chance – the Australian ship was alone and the Australian captain, for whatever reason, had brought HMAS *Sydney* much too close, well within easy range of *Kormoran*'s torpedoes. If he had to scuttle *Kormoran* to prevent capture of his enigma machine, he would do so – those were his orders – but at this very close range the Germans might actually have an even chance, if they chose to fight. At point blank range, the advantage of surprise might allow them to inflict severe damage on *Sydney*, before the Australians could respond with their superior longer-range weapons. If his disguise failed, the German captain would first try to fight, leaving scuttling as his last resort.

Sydney asked again for the ship's name and destination – a clear sign that they had not been able to read the *Kormoran*'s signal flags, earlier. The Germans replied according to their Dutch disguise, '*Straat Malakka*. Destination Batavia'. Evidently disbelieving, Sydney asked them to display *Straat Malakka*'s secret call sign, known only to allied ships. Realising that the game was up, *Kormoran*'s crew replied by firing two torpedoes at *Sydney*'s vulnerable hull, only 1,000 yards away. Rapid and accurate shellfire from her four 6-inch guns exploded into *Sydney*'s bridge, gunnery control tower and forward gun turrets. Continuous machine gun fire killed the exposed crews manning *Sydney*'s torpedo tubes and secondary guns, preventing their use. *Sydney*'s main guns fired back, but when a torpedo struck the hull directly under the two forward turrets, their four guns fired no more. Within a minute or two, Sydney's bridge and other command spaces were completely destroyed, all senior officers killed or wounded, all of her secondary weapon crews killed by machine gun fire and half of her main guns knocked out by the torpedo blast. *Sydney* swung wildly to port, straight towards *Kormoran* – the Germans thought she was trying to ram them, in a last attempt to take them to the bottom – but the *Kormoran* increased speed and *Sydney* just missed, passing close astern. One of her remaining gun turrets had now jammed facing the wrong direction, leaving only the final turret, with its two 6-inch guns, to face *Kormoran*'s continuing barrage. But those two guns were enough to inflict fatal damage on a merchant raider. Shells exploded in *Kormoran*'s engine room destroying her engines and starting fuel fires that could not be controlled. As the burning *Sydney* steamed slowly away, *Kormoran*'s guns fired shell after shell into her hull, until she was out of range. Later, when *Kormoran*'s uncontrolled fuel fire was approaching her supply of explosive mines, the German captain gave the order to abandon ship and set off the scuttling charges to let the sea put out the fire before the crew could be killed by exploding mines. The Germans reported last seeing *Sydney*, from their life rafts, heading slowly south-southeast, toward her home port of Fremantle, burning furiously from the bridge to the stern. Later, in the darkness, they saw the orange glow of her fires, over the horizon. Then they flickered and went out.

So said the German informants, but many Australians, including the families of the sailors lost on HMAS *Sydney*, found the German account unconvincing. At best, some thought, the German merchant raider must have been operating in cooperation with a Japanese submarine. Perhaps the German merchant raider lured HMAS *Sydney* toward it to investigate its identity, from a safe distance, while a Japanese submarine lurked nearby to torpedo the preoccupied warship.

Prisoners of war are not required to provide more than minimal information, under interrogation, and the German sailors were initially reluctant to say anything. But allegations had been raised that the German crew may have been involved in some sort of war crime – perhaps operating with a submarine from a non-combatant nation (Japan) and then machine-gunning the Australian survivors to remove all witnesses to their crime – and some of the Germans had been threatened with these allegations during their interrogation, in an attempt to make them cooperate. But this threat of a war crimes charge gave them a *motive* to protect themselves – if necessary, by lying. From that moment on, it was impossible to know whether the German informants were providing honest and accurate information, honest but inaccurate misinformation, or dishonest disinformation intended to protect themselves from a war crimes charge.

In the late-1940s, with wartime feelings still fresh in people's memories, it was perhaps understandable that most of the Australian public rejected the Germans' account of what had allegedly happened to HMAS *Sydney*, but doubts persisted well into the 1990s, even among generations born after the war. Several searches were conducted for the wrecks of both ships, but the perceived credibility of the German evidence was still so low, that those searches were conducted far away from where the German captain had said his ship went down. His report was treated as deliberate disinformation intended to lead investigators away from the true location of the wrecks which might, it was thought, reveal evidence of a war crime such as machine-gunning Australian survivors in their life rafts. The one piece of wreckage that had been recovered was an Australian life raft which *was* riddled with holes and this gave greater credence to the war crime theory. Was this continued rejection (or, at least, questioning) of the German evidence reasonable?

Using the Admiralty Code to rate the German survivors as information sources, we will be interested in their reputations, their motivations and their competence as witnesses. Reputation is difficult to judge, in this case, but in the 1940s, these German sailors may have had a reputation for untrustworthiness thrust upon them, partly due to wartime prejudice and partly due to the appalling actions of their Nazi government. In terms of motivation, the first point is that these witnesses were not innocent bystanders. The account of the battle that emerged would affect their reputations among Australians but, more importantly, among their fellow Germans. By November 1941, all of Europe was either defeated, neutral or allied to Germany, Britain had been isolated and neutralised as a European land-power, and the German army was approaching Moscow. These German sailors expected to be sent home as heroes, probably in 1942, as soon as Germany had defeated the Soviets, turned its forces back towards the west, forced Britain to negotiate peace terms and won the war. One of their motivations, we can reasonably assume, was to be loyal to their nation and to their navy, which might be regarded as a reason to portray the events of that day in a way that reflected well on the German navy and on themselves – brave German sailors fighting honorably against a superior ship and prevailing, thanks to superior German tactics and leadership. Once they had been threatened with a war crime charge, a new motivation came in to play – self-protection and self-preservation. The punishment for a war crime could be severe, even execution. It was the Australian interrogators who gave the German sailors this motivation, but once it was done it was done. They now had a motivation to say whatever it took to save their own lives. On the question of competence, the Australian interrogators were very thorough: determining which sailors had been in a position to see and hear things directly and which sailors were merely recounting claims they had heard later from their crew-mates, as they floated in life rafts or sat in internment camps. But, in any case, the main doubt about these witnesses, as a source of information, arose from the motivations that were assumed to be behind their story. It was thought that they had made up a story, portraying themselves as innocent, to protect themselves from an Australian war crimes charge. As a source, they might have been rated D or E.

In rating the German account of events, many of their claims are quite plausible and consistent with Australian and German naval procedures and the historical record of previous naval engagements, but there are two glaring inconsistencies:

1. The German account claims that HMAS *Sydney* drew close alongside them, which allowed them to torpedo her, but the Australian navy had a clear procedure for identifying suspicious ships which involved standing off at a safe distance where the warship would have an overwhelming advantage in longer-range weaponry, and sending a small motor launch in to do the close identification. The German account requires us to accept that the 'best ship in the Australian navy' completely ignored its own navy's procedures.
2. The German account claims that they last saw Sydney, on fire, heading slowly over the horizon in a south-southeasterly direction, apparently under control. The German ship was also on fire, yet the majority of the German crew were able to abandon ship under controlled conditions and survive in their life rafts until they reached the coast or were picked up at sea. From HMAS *Sydney*, there were *no* survivors, *no* bodies and *no* wreckage, except for one unmanned life-raft, riddled with small holes (now on display at the Australian War Museum in Canberra). In the history of modern naval warfare, only a tiny number of warships had been lost with no survivors and those few had been blown apart when their magazines exploded catastrophically. *Sydney* had not exploded. Why, then, had none of her crew been able to abandon ship? The German account requires us to accept that HMAS *Sydney* went down in a way that was utterly unique in the history of naval warfare.

Many of the Germans' detailed claims are plausible, but since they can't be verified via other sources, they would be rated no higher than 3 on the Admiralty Code's scale of likely validity. The two problematic claims, described above, are crucially important to the German account but they are inconsistent with other known facts. They present us with two incredible surprises: (1) that *Sydney*'s captain and other senior officers disregarded their navy's procedures – not something that military forces are in the habit of doing, and (2) HMAS *Sydney* did not explode, but somehow still managed to disappear suddenly and catastrophically, leaving no survivors – an event unique in modern naval history. Those two claims would be rated very low on the Admiralty Code's scale of likely validity.

It was the apparent implausibility of these two key German claims that opened the door to some barely-more-plausible alternative theories, which formed the basis of the war crimes suspicion. *Kormoran* had no weapons that could damage

Sydney severely at the long range required by the Australian navy's procedures. Only a lurking submarine could have done that and, in that part of the world, it could only have been a Japanese submarine. Apart from a few catastrophic magazine explosions, no warship in modern history had gone down without survivors, but the lack of survivors might plausibly be explained by a German (or Japanese) decision to finish off *Sydney*'s survivors with machine-gun fire as they floated helpless on their life rafts – a theory consistent with the one life raft that was found, riddled with holes, and a ruthless decision which might have been made to conceal Japanese involvement, 18 days before their planned attack on Pearl Harbor.

For over 60 years, the Australian public's unwillingness to accept the German eyewitness accounts as credible evidence, was probably quite reasonable. But the meagre evidence supporting the conspiracy theories was no better and the most reasonable position to have taken, before 2008, would have been to acknowledge that we simply didn't know what happened to HMAS *Sydney*. Only further inquiry might help resolve the controversy.

In 2008, another search was mounted for the wrecks of *Kormoran* and *Sydney*. This search was funded by the *Finding Sydney Foundation*, an independent non-profit organisation, and conducted by *Blue Water Recoveries*, a highly-reputable British deep-sea search and salvage company, led by David Mearns, an American-born marine scientist and deep-sea search expert. While conducting background research in preparation for this task, Mearns had been shown a German-English dictionary, by the nephew of the German captain, in which the captain had encoded a secret account of the battle for his superiors in Germany, based on *Kormoran*'s log book. When decoded and translated by Captain Peter Hore RN, this account was almost identical to the German captain's testimony under interrogation in 1941 (Hore & Mearns, 2003). Although self-promotion might still have been a motivation behind some aspects of the coded dictionary account, as seems to have been the case in his published post-war narrative (Detmers, 1975), self-preservation clearly was not, since the coded dictionary was never seen by Australian authorities, during the war.

Mearns started the 2008 search by assuming that the German account of the battle location might be correct. It was; the wreck of *Kormoran* was found just where the Germans had always said it would be. Following the German account, Mearns then searched in a south-southeasterly direction and found the wreck of HMAS *Sydney* 11.4 nautical miles (13.1 miles or 21 km) away from the wreck of *Kormoran* (Mearns, 2009). The German captain's claim about the location of the ships had now been verified by an independent source.

Mearns's expedition produced around 40 hours of video footage, closely examining both wrecks. Validation or invalidation of the German accounts and the main conspiracy theories was a priority. The Germans had claimed that *Sydney* drew surprisingly close to their ship, despite the Australian navy's procedures, and that they were able to torpedo *Sydney* beneath her forward main gun turrets. The video footage shows flat-trajectory shell holes on both wrecks, indicating a battle at point blank range. It also shows damage from smaller guns and machine guns around *Sydney*'s torpedo tubes and secondary guns, just as the Germans had claimed, again indicating a very close range battle. The video footage shows massive torpedo damage beneath *Sydney*'s forward main gun turrets and reveals, for the first time that *Sydney*'s entire bow section eventually broke off, as a result of that torpedo damage. A burning ship breaking in two and sinking rapidly, while its only living crew members were below decks, would explain the lack of survivors. The presence of small boats and life rafts, some still attached to the wreck, show that few, if any crew-members were able to abandon ship. Indeed, every German claim that was able to be checked against physical evidence from the wrecks has now been verified. Step-by-step, through the 40 hours of video footage, the track record and reputation of those German informants gets better and better. Many German claims remain untested, but none have been invalidated and those two big, problematic claims that led so many to doubt the German testimony have now been verified. David Mearns's video evidence from the sea floor would rate very close to A1 and, since it verifies the most controversial German claims, the Germans, themselves, must now be regarded as reliable informants – their verified claims are now rated as A1 or B1 and even their unverified claims as A3 or B3. Indeed, it might now be reasonable to rate one German's claim as verified if it is consistent with claims made by other Germans, during interrogation, since they have now been shown to be very reliable eyewitnesses.

Conclusion

The HMAS *Sydney* case illustrates the value of The Admiralty Code as a cognitive tool for guiding learners and investigators in evaluating claims and evidence. In information environments characterised by competing claims from a range of sources, the Admiralty Code (or NATO System) can assist an inquirer to focus on two crucial factors for evaluating the credibility of those claims: the competence and motivations of the informant, and the consistency of the claim with what else is known.

Learning how to engage in self-direct inquiry is one of the main learning objectives of inquiry-based teaching methods in education (Barrows, 1990; Bereiter, 2002a, 2002b; Bereiter & Scardamalia, 2000, 2003; Feltovich, Spiro & Coulson, 1997; Scardamalia & Bereiter, 1996, 2006; Schon, 1983,1987; Wells, 1999, 2000, 2002). But the benign information environments of most school- and college-based education programs, do not require learners to deal with the quantity of information, typically yielded by even a basic Google search. More importantly, those benign information environments, designed and managed by teachers, tutors and professors, do not expose students to large quantities of misinformation or disinformation, so students are not often confronted with the challenges of evaluating the credibility of claims, assessing the validity of arguments or weighing up competing explanations. Yet, when they engage in self-directed inquiry, beyond school, they often have to work in misinformation-rich and even disinformation-rich environments. The Admiralty Code is a cognitive tool which is relatively easy to learn to use. If its use was integrated into inquiry-based education programs, it would help students to become better at engaging effectively in self-directed inquiry and, hence, improve the educational effectiveness of those programs.

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