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Information: a Literature Review

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Information: A literature review

Philip Smith

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Intro, purpose, two-fold:

1. What is information?
   - Not a rigorous dictionary definition, an operational or functional one, how is it used in everyday life and various academic/knowledge discourses

2. Given this discussion of information; what is information literacy?

DIKW “Knowledge or Information Hierarchy”

I’ll use this as a general framework:

- Became a popular schemata in the 1980’s: Ackoff, Adler, Zeleny
  - Even earlier, T.S. Eliot: “Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?”
  - With this, descending direction, top to bottom
- Not without its critics: Martin Fricke
  - Based on outmoded metaphysics of materialism, positivism
- But still usable for my purposes here
- Usually presented as a bottom-up progression: data informs information informs knowledge informs wisdom. Some kind of refinement or contextualization of one leads to next level

Some quick examples:

1. Weather station:
   - unmanned shed on a mountain records daily temperatures, barometric pressure, rainfall, etc. – this is raw data
   - Becomes information if I want to know, for instance, the high temperature on my birthday
   - By studying trends in data and info you begin to see patterns, i.e. when the barometer drops it usually storms – this is a kind of knowledge
   - Wisdom here might be, knowing to take the laundry off the line and take shelter

2. Sales receipts
   - Data: record of items sold, how much money taken in
   - Info: How many of those red shirts on sale did we sell? Info often answers directional questions of “how much”, “who”, “when”
   - Knowledge: seeing a pattern, i.e. when something is on sale and we advertise it we sell more of it
   - Wisdom: knowing when to put x item on sale, for how long, and so

Take home point: I want to distinguish data and information on the one hand from knowledge wisdom on the other, and do this in terms of parts and wholes.

Information is partial, fragmentary, inconclusive, without context on its own. As opposed to knowledge which is a larger whole immediately intuited.
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- Gestalt psychology example for wholes and parts: you don’t just see splotches of color, your mind automatically constructs a larger image. This image is made of information, but the information itself becomes transparent in the process.
- Literacy example: once you know how to read, you don’t focus on the words and letters but the meaning.

Knowledge is made up of information but not reducible to it. And information tends to become transparent as it is used or enlisted by knowledge.

So data and information are on one side, knowledge and wisdom on the other.

Claude Shannon is often credited as one of the foundational figures of information theory for information technology systems. His theory of information fits this fragmentary definition of information, because content is irrelevant to transmission. It doesn’t matter what the information is, only how big it is, bandwidth you need to transmit it without error. So here information is quantified as bits which reduce uncertainty. What is important to us as the human communicators is the content of the message, what we are trying to communicate an image or narrative – a knowledge. But what’s important to the system is just the details, the information that needs to be faithfully maintained as it travels across the wire.

Information is also an index of complexity and order. The more parts and details, the more intricate a system, the more information it has.

- The circle and the scribble diagram; which has more information?
- The scribble (167 KB (171,656 bytes)) does; for circle (13.3 KB (13,703 bytes)) I can just say circle and you have a pretty good idea what it will look like. The word “circle” is actually a kind of algorithm which compresses the information that needs to be transmitted. For scribble, I can say scribble and you’ll have a vague notion, but you won’t know the exact path of all the tangled lines, there is no way to compress that detailed information into a simple word.

In physics, information is also an index of the self-organizing force working against entropy in the universe. The second law of thermodynamics, entropy, states that all systems lose energy – and the universe itself is just such a closed system –move from order to disorder, with everything eventually burning up and sinking into an undifferentiated haze. This may be our ultimate fate, but in the meantime we can easily see in the world around us that things are becoming progressively more differentiated, complex, and highly ordered. Life evolves from simple to complex organisms. Data evolves into information then knowledge and wisdom. Civilizations rise from humble agricultural beginnings and sprout into sprawling cities full of exotic sights, buildings, palaces, practices, religions, rituals, and beliefs. Technologies evolve at an even faster pace, computers get more powerful and less expensive all the time. Technologist Kevin Kelly calls this tendency exotropy, which is a kind of negative entropy. Left alone, physical systems decay and die out, everything sinks to a bland uniform sameness. But exotropy describes how the universe, at least for a time in our little corner of it, resists this heat death and evolves into progressively more advanced forms. Kelly describes this in terms of the information

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theory we just discussed which he describes as “a signal of bits that makes a difference” (63). Things evolve from the simple to the complex, the pure energy from the big bang expands and becomes atoms and matter and eventually forms the conditions which give rise to life and life progressively evolves more refined and complex forms; each step in this sequence can be quantified as an increase of information. More bits, more signals and messages, more differences. So physical, material reality itself can be defined by, though not reduced to, information.

Interesting point: Information isn’t all that interesting or useful in itself, yet we are obsessed with it, this is the information age, and recognize the great power it has. The zeitgeist used to be “knowledge is power”, now it is more like “information is power”.

• Descent down the knowledge hierarchy:
  o axial age – wisdom, circa 800 to 200 BCE, high point in Classical civilizations, in Athens, time of Plato and Aristotle; in China, Confucius and Lao Tzu; In Persia, Zoroaster; So this is when a lot of the philosophical and spiritual foundations of World civilizations were laid
  o Enlightenment/Industrial Revolution – “knowledge age” – late 17th and 18th century, scientific method and rationality, the encyclopedia project, revolutions in science, art, politics
  o now post-industrial age is information age, emphasis on information technology, service economy over production economy, post-modernism, relativism, and so on. Main point again: Information is power.

Other evidence that information is power:

• Biology, genetic engineering: DNA as life-code, Schrodinger via James Watson: the essence of life is information, we are made of information
• Information is personal: Not only are we made of information, we make information. Our information shadow: Traces of individuals in digital form: browsing history, banking records, credit card purchases, cell phone tracking, GPS devices, the whole rubric of Privacy
• Information is social: aggregated population trends
  o Easy to spy on individuals and control populations; telemarketers and homeland security agents
  o Those in political power are also vulnerable: Arab Spring and Wikileaks show this

Though information is power, it has limitations. Limitations of information: it is parts, fragments that are needed to make up wholes (Images, stories, narratives). Two points:

• Wholes cannot be reduced to parts; or, given a collection of parts, you cannot predict or detect wholes that may emerge, emergent properties. So just looking
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at information, out of context, as an aggregate, doesn’t allow you to see the bigger picture, the knowledge/discourse/image/story that may emerge
  o Biological organisms cannot be reduced to their DNA
  o Human personalities cannot be reduced to their digital shadow

• Parts can used and re-used, re-tooled to make up other wholes. Narratives can be deconstructed, threads weaved into new stories
  o Example: Gestalt-ish, Duck or rabbit; old hag or pretty girl picture: same info, different image
  o Example: remix culture, mash-ups, collage art: with this, you see information is very political. I said earlier that information is neutral, and this is true in one sense but in another sense information, or information use, is very much a political activity. It is never neutral; how you interpret, use, re-use, and spread information is always done in value-laden contexts.

Overload: Information is thus really a simple, humble kind of thing. In itself it is totally neutral, inert. It has tremendous potential, but disappears into knowledge/meaning once it is actualized. It is also difficult to pin down because when you try to study it in isolation it tends to dissolve into mere data or coalesce into the larger meaning it is supporting (kind of like how you have to ignore the sound or sight of words in order to understand the meaning they are trying to convey). This is also why there is always too much information. This too-muchness, this excess is not just a contingency of whatever information-seeking / information-using situation we find ourselves in, it is intrinsic to the nature of information itself. Consider this sensory and consciousness bandwidth chart.

Bandwidth, Sensory and Consciousness

<table>
<thead>
<tr>
<th>Sensory Input</th>
<th>Total Bandwidth (bits per second)</th>
<th>Consciousness bandwidth (bits per second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes</td>
<td>10,000,000</td>
<td>40</td>
</tr>
<tr>
<td>Ears</td>
<td>100,000</td>
<td>30</td>
</tr>
<tr>
<td>Skin</td>
<td>1,000,000</td>
<td>5</td>
</tr>
<tr>
<td>Taste</td>
<td>1,000</td>
<td>1</td>
</tr>
<tr>
<td>Smell</td>
<td>100,000</td>
<td>1</td>
</tr>
</tbody>
</table>

(M. Zimmermann, Human Physiology)

Just as the eyes can register ten million bits a second but only 40 of those bits reach our

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awareness, so it is only a tiny fraction of all the information on a given topic can enter our minds or academic discourse or public discourse as a kind of knowledge. So the 9,630,000,000 results I get when I Google the word “information” is meaningful in more ways than first appears. Most of these results are mere information in the sense I have been describing here; bits of potential messages, potential meaning, potential knowledge that could be put to some use or other, could be made into any of various meanings, nourish any of various bodies of knowledge, but which to my narrow bandwidth will largely remain unsorted, unfiltered, unused. In other words, it remains simple information. The results are more than just data – I could click any of these pages and be lead into a nexus of meaning and knowledge – but in themselves as they appear to me as search results, they have no meaning and do not add to my knowledge.

So information is details, fluid, and neutral. It is the stuff which makes up our knowledge, our bodies, our personalities, our perceptions, our narratives, our discourses, but if you just considered it on its own, just looked at the lines on the paper, DNA, and digital shadows you wouldn’t have knowledge, bodies, and discourses, you’d just have a bunch of meaningless information.

It’s how the information is used that is important. This is a key component of information literacy. So one sense of IL that emerges from this discussion is of information literacy as a skill. It is something you do; what you do is manipulate the information to create a whole. IL could also be the ability to read the info that sustains a given narrative and re-interpret it, re-use it to fashion a different narrative. This is what happens in a paradigm shift. The information feeding a certain discourse is suddenly seen in a new light and put to the service of a whole new kind of knowledge.

Another point about IL: We tend to approach it from the knowledge side. We think of it in terms of lifelong learning, critical thinking, evaluating, all with the end of making students better educated and better citizens and well-rounded and so on. But it’s not “knowledge literacy”, it should be about this attention to detail and this skill with using information to construct and deconstruct narratives.

I think this betrays some deep-seated confusion or uncertainty within our discourse and field of practice about what IL is and what it should be doing. IL has a bit of an identity-crisis going on. On the one hand, I think IL is sometimes enlisted as a kind of liberal art, or perhaps even picking up the mantle or slack of this model of liberal arts education which seems to be under increasing attack and also decaying from within (but that is another story). On the other hand, IL is sometimes reduced to mere library skills, searching skills, or research skills.

I think this is also reflected in the literature where a debate continues about how to best teach IL: should it be integrated into specific disciplines? Or should it be a standalone class and subject? Is IL a distinct subject or is it more like a “threshold concept” within each discipline, a kind of skill and understanding that develops naturally as one is steeped in the field?
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This is more than an academic question, as how we conceptualize IL will largely determine how we teach it and present it to faculty and administrators.

Tentative conclusions:

IL should be included in the liberal arts, but certainly isn’t a replacement for them. It may be a shot in the arm and an inoculation against obsolescence, it can fortify but not form the main substance.

IL is mainly a skill. Something you know how to do. As such it is not only multidisciplinary but perhaps one of the few remaining avenues of intellectual pursuit that attempts a universal survey of knowledge, wisdom, information, and data in this age of specialization. Ironic that the information age is also the age of specialization. This may be because information itself is details. Information literacy though always has one foot on the knowledge side of the hierarchy, it is always concerned with the story we are telling ourselves.

References

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Data - Information - Knowledge - Wisdom: The Knowledge Hierarchy

Originators:


Some Critics:


Gestalt Psychology


Information Theory


Entropy and Extropy
Information: A Literature Review


DNA


Personal and Social Information


Information Overload


Information Literacy and Liberal Arts


Information: A Literature Review
