Bridging science education and science communication

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Stupid decisions are to blame for Europe’s record measles rate

Italy’s right wing is waging a dangerous attack on vaccinations

Romania’s measles outbreak kills dozens of children

As Measles Surges, ‘Decades of Progress’ Are in Jeopardy
What knowledge is required in order to decide whether to get vaccinated against measles?
What knowledge is required in order to decide whether to get *vaccinated against measles*?

Eat genetically modified food?

Approve genetic engineering of babies?

Do something about global warming?

.....
“One of the primary goals of teaching science in school is to provide these people the wherewithal to deal intelligently with science and scientists despite their lack of scientific expertise” (Norris, 1995)
Disciplinary literacy

- **Basic Literacy**: Decoding and knowledge of high frequency words
- **Intermediate Literacy**: Generic comprehension strategies, common word meanings, and basic fluency
- **Disciplinary Literacy**: Skills specialized to subject areas (e.g. History, Science, Literature & Math)

(Adapted from Shanahan & Shanahan, 2008)
The adaptation of scientific articles lowers the lexical complexity, while at the same time retaining the main linguistic features of the primary articles and the authenticity of the scientific writing

(Ariely & Yarden, submitted)
Demonstration of inquiry skills following reading APL or Popular text

12th graders

Future investigation
Critical thinking
Application

Relative score
Primary (n = 17) Secondary (n = 10)

High-Knowledge 10th graders

Future investigation
Critical thinking
Application

Relative score
Primary (n = 24) Secondary (n = 25)

*p ≤ 0.05, **p ≤ 0.01 ; Analyzed by t-test

(Baram-Tsabari & Yarden, JRST, 2005)
Instructional strategy – contradictory articles

Providing students with textual resources that convey contradictory viewpoints can increase the likelihood that they discuss and explore the differences between them.

(Asterhan & Schwarz, 2016)
Does the genre of the contradictory articles (APL vs. popular) influence students’ ability to critically assess a popular article?

Comparison between the pre- and post-tests (total criticism) of the popular articles and APL articles groups. *p<.05 (one-tailed T-test).
What is the knowledge that is required to become a critical consumer of scientific information?
Is adapted primary literature the answer?
Bridging science education and science communication

Science Education
Science literacy

Science Communication
Public engagement with science
Well of science

Reflective citizens (OECD, Osborne)

Competent outsiders (Feinstein)

Bounded understanding of science (Bromme)

Functional science literacy (Ryder)
Public Engagement with Science
Public Engagement with Science

Czech Wikipedia user Pack

Sylvia Duckworth

WELLS - SUSTAINABLE WATER SUPPLIES
Public Engagement with Science
What evidence is there that science education supports evidenced-based decisions?
The usefulness of science knowledge for parents of hearing-impaired children

Sophie Shauli and Ayelet Baram-Tsabari
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• General science knowledge is useful for developing contextual science understanding
• Parents who displayed higher contextual science knowledge emerged as having slightly better.

Formal Scientific background

\[ \Delta R^2 = 0.258 \]
\[ \beta = 0.414 \]

Years of Education

\[ \Delta R^2 = 0.03 \]
\[ \beta = 0.198 \]

General Scientific Knowledge

\[ \Delta R^2 = 0.142 \]
\[ \beta = 0.387 \]

Contextual Scientific Knowledge

\[ \Delta R^2 = 0.055 \]
\[ \beta = 0.252 \]

Advocacy Knowledge and Attitudes
Engaging in argument on subjects

Fluoridation of drinking water
N = 895 (2012-2014)
N = 266 (2015)

Polio re-vaccination
N = 401 (2013)

What do people mean by “healthy food”?
N = 9,443 non-commercial items (2017)

Climate change
N = 648 (2011-2012)

Animal experimentation
N = 684 (2009-2010)
What did we look for? Transfer!

1. Procedural knowledge
2. Epistemological knowledge
3. Engaging in argument from evidence
4. Science content knowledge
Engaging in argument from evidence

The discourse was almost entirely detached from scientific backup

Of 401 items: 96% did not present any evidence to support their argument

Of 9,443 items: 96% did not present any evidence to support their argument
What do people mean by “healthy food”? (n = 9,443)

Veracity of 500 randomly selected claims from Facebook discussions about ‘healthy food’ Orr and Baram-Tsabari (in preparation)

Supported: “You should switch to natural food coloring. It is not as pretty, but it is much healthier”

Evidence do not exist: "Drink tea with lemon and honey twice a day and you will be healthy as an ox"

Refuted: “Aluminum foil is poisonous”

Vague: “popcorn is not healthy”

4% 51% 14% 27% 8%
Components of Science Literacy
(National Academies of Sciences, Engineering and Medicine, 2016)

1. Foundational literacies
2. Content knowledge
3. Understanding of scientific practices
   4. Identifying and judging appropriate scientific expertise
5. Epistemic knowledge
6. Cultural understanding of science
7. Dispositions and habits of mind, such as inquisitiveness and open-mindedness

★ Common to most applications of science literacy
What components of science literacy are most relevant to becoming a critical consumer of scientific information?

Knowing which expert to trust