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Integration and Assessment of Information Literacy in an Undergraduate Biology Program: a Sustainable and Transferrable Model

Brian Winterman

Indiana University - Bloomington

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INTEGRATION AND ASSESSMENT OF INFORMATION LITERACY IN AN UNDERGRADUATE BIOLOGY PROGRAM

A Sustainable and Transferrable Model

Brian Winterman
Indiana University Libraries
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IN THE BEGINNING… (2004-2006)

IS THIS REALLY NECESSARY?
SHIFTING THE FOCUS (2006-2010)

• “Product of the program”
• Established BUILD working group (Biology Undergraduate Information Literacy Development)
• L301 and L322 (My information literacy playgrounds)
• Research Grants: Development of model exercises
THE PICTURE THAT EMERGED (2010)

**TIER 1**
- Science Seeker/Foundations
  - Nature and structure of information: reflects science
  - Summarizing info of different types in increasing complexity; connections
  - Formats of documents
  - Data analysis and reporting

**TIER 2**
- News and Views
  - Personal position addressed to general audience
  - Variety of info used
  - Comprehend and explain

**TIER 3**
- Research proposal
  - Exhaustive literature search
  - Identify gaps in knowledge
  - Propose and justify solutions
THE CHALLENGES OF IMPLEMENTING

SIZE - COMMUNICATION - SUSTAINABILITY - AUTHENTICITY
CONCURRENT INITIATIVES AND OTHER FACTORS (2010-2012)

- Biology program goals
- Campus assessment task force (program review mandate)
- Professional Development (Immersion/RAILS; grants)
- Changes in the Libraries (T&L Department)
SEA SCHOLARS (2012-PRESENT)
(SCIENCE EDUCATION ASSESSMENT SCHOLARS)
LEARNING OUTCOMES

Tier II: Perspectives

The primary focus of students at Tier II is to learn how to use the scientific literature to propose a perspective about a problem or question in biology. This will generally involve synthesizing information from more than one primary or secondary source. After learning how to state a position and support a claim with evidence, biology students will be prepared to use the list to support novel hypotheses in Tier III.

LEARNING OUTCOMES

These learning outcomes were designed to describe the competencies that are finding, understanding, and applying scientific information. They can be classified as learning outcomes, although it is not crucial that each assignment addresses all of them. The learning outcomes are in bold is the critical cognitive process that should be mastered.

The student will:
1. Identify and refine a question or argument that can be addressed
2. Use tools strategically and efficiently to access relevant information
3. Identify multiple complementary resources (primary, secondary) and appropriately use the information found in each
4. Extract necessary information from specific sections of a text
5. Evaluate the general methodological approach and the design in order to identify benefits and drawbacks
6. Integrate a figure from literature in the context of the text
7. Synthesize information from multiple resources in order to support a claim or observation
8. Cite sources consistently and accurately

Examples of Tier II Assignments
- A critique of 2–3 related primary articles (interpretation of how these articles are related)
- A poster that contains information about 2–3 sub-figures that synthesize information from those figures
- An oral presentation in which a student expresses his/her ideas

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<table>
<thead>
<tr>
<th>Tier I</th>
<th>Relevance to course/ NATURE AND STRUCTURE</th>
<th>Tier II</th>
<th>Relevance to field/ significance / PERSPECTIVES</th>
<th>Tier III – Relevance to current/future stuff/ novelty innovations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Select course-relevant topic to investigate</td>
<td>1. Articulate and refine question to investigate (why do you need this info? What are you trying to investigate? This is there.) (outlining)</td>
<td>1. Articulate gap to investigate (why do you need this info? What are you trying to investigate? This is there.) (outlining)</td>
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</tr>
<tr>
<td>2. Summarizes the information available in different types of sources (primary, secondary, etc) and makes explicit connections among these sources</td>
<td>2. Identifies multiple complementary resources (primary, secondary, etc.) and appropriately uses the information found in each</td>
<td>2. Identifies the most current and significant literature sources (primary, secondary, etc.) and appropriately uses the information found in each</td>
<td></td>
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<tr>
<td>3. Uses appropriate tools (indexes, catalogs, etc.) to access scholarly sources</td>
<td>3. Uses tools strategically and efficiently to access relevant scholarly sources</td>
<td>3. Uses tools strategically and efficiently to access relevant scholarly sources</td>
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<tr>
<td>4. Identifies the sections of a primary research article and their purposes</td>
<td>4. Extracts necessary information from specific sections of a primary article</td>
<td>4. Strategically and efficiently extracts necessary information from specific sections of a primary article</td>
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<tr>
<td>5. Describe the general methodological approach and the logic of the experimental design</td>
<td>5. Evaluates the general methodological approach and the logic of the experimental design in order to identify benefits and drawbacks</td>
<td>5. Evaluates methodological approaches in order to design an appropriate experiment that addresses outstanding questions in the literature</td>
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<tr>
<td>6. Summarize information from primary and secondary literature</td>
<td>6. Synthesizes information from multiple resources to provide perspective on a topic</td>
<td>6. Synthesizes information from multiple resources to construct an argument for proposed results</td>
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<tr>
<td>7. Cites sources including recognizing when an idea is common knowledge</td>
<td>7. Cites original source of information to support claim or observation; Accurately portrays others conclusions</td>
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<tr>
<td>8. Quotes and paraphrases and attributes accurately and appropriately</td>
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<tr>
<td>9. Interprets a figure from literature in the context of the study.</td>
<td>9. Interprets a figure from literature in the context of the study.</td>
<td>10. Interprets a figure from literature in the context of the study.</td>
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</tr>
<tr>
<td>a. Poor:</td>
<td>a. One issue I can see with this is how we can observe this without doing a LOT of extra work?</td>
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<td></td>
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<tr>
<td>b. Good: Explains some aspects of figure (axes, legends, AND/OR results)</td>
<td>b. Less reliance on quotations (should be synthesizing!)</td>
<td>b. Less reliance on quotations (should be synthesizing!)</td>
<td></td>
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<tr>
<td>c. Excellent: Explains all aspects of figure AND interprets results</td>
<td>c. Maybe don’t need #9?</td>
<td>c. Maybe don’t need #9?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Cites sources including recognizing when an idea is common knowledge</td>
<td>11. Attributes quotations and paraphrased information in an accurate and appropriate manner.</td>
<td>11. Attributes quotations and paraphrased information in an accurate and appropriate manner.</td>
<td></td>
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</tr>
<tr>
<td>a. Poor: Plagiarizes</td>
<td>a. Less reliance on quotations (should be synthesizing!)</td>
<td>a. Less reliance on quotations (should be synthesizing!)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Good: Cites sources in (author, date) format</td>
<td>b. Less reliance on quotations (should be synthesizing!)</td>
<td>b. Less reliance on quotations (should be synthesizing!)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Excellent: Cites sources only when needed (not for common knowledge info)</td>
<td>c. Excellent: Cites sources only when needed (not for common knowledge info)</td>
<td>c. Excellent: Cites sources only when needed (not for common knowledge info)</td>
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<tr>
<td>d. Maybe don’t need #9?</td>
<td>d. Maybe don’t need #9?</td>
<td>d. Maybe don’t need #9?</td>
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</tbody>
</table>
## LEARNING OUTCOMES (THE PROCESS)

### Tier I: Relevance to course/ Nature and Structure
1. Select course-relevant topic to investigate
2. Summarizes the information available in different types of sources (primary, secondary, etc.) and makes explicit connections among these sources
3. Identifies the sections of a primary research article and their purpose
4. Describes the general methodological approach and the logic of the experimental design
5. Evaluates the general methodological approach and the logic of the experimental design in order to identify benefits and drawbacks
6. Synthesizes information from multiple resources to provide perspective on a topic
7. Cites original source of information to support claim or observation
8. Quotes and paraphrases and attributes accurately and appropriately
9. Interprets a figure from literature in the context of the study.
   - Poor: Explains some aspects of figure (axes, legends, etc.)
   - Good: Explains all aspects of figure AND interprets results
   - Excellent: Explains all aspects of figure AND interprets results

### Tier II: Relevance to field/ significance / Perspectives
1. Articulates a gap to investigate (why do you need this info? What are you trying to investigate? – “gap” is important – what information is needed to indicate that investigating this is necessary?; Identify current gaps in knowledge on a scientific subject and generate a question gap in knowledge. Identify the societal implications of research.
2. Identifies the most current and significant literature sources (primary, secondary, etc.) and appropriately uses the information found in each
3. Uses tools strategically and efficiently to access relevant scholarly sources
4. Strategically and efficiently extracts necessary information from specific sections of a primary article
5. Evaluates methodological approaches in order to design an appropriate experiment that addresses outstanding questions in the literature
6. Synthesizes information from multiple resources to construct an argument for proposed conclusions
7. Cites original source of information to support claim or observation
   - Accurately portrays the findings/conclusions of cited papers
   - One issue I can see with this is how we can observe this without doing a LOT of extra work
8. Quotes and paraphrases and attributes accurately and appropriately
9. Interprets a figure from literature in the context of the study
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    - One issue I can see with this is how we can observe this without doing a LOT of extra work

### Tier III – Relevance to current/future stuff/ novelty innovations
1. Articulates and refines question to investigate (why do you need this info? What are you trying to investigate? This is there.
   - Outlining)
2. Identifies multiple complementary resources (primary, secondary, etc.) and appropriately uses the information found in each
3. Uses tools strategically and efficiently to access relevant scholarly sources
4. Extracts necessary information from specific sections of a primary article
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11. Attributes quotations and paraphrased information in an accurate and appropriate manner
    - Less reliance on quotations (should be synthesizing!)
LEARNING OUTCOMES (GAP ANALYSIS)

Students graduating from our program will be able to:

1. Apply the scientific method to formulate biological questions and problems.
   This skill requires students to:
   - Make observations
   - Identify significant open questions
   - Formulate hypotheses
   - Design experiments
   - Learn modern laboratory techniques
   - Collect and document data
   - Analyze, interpret, and present results
   - Collaborate with others to solve problems
   These activities will enable students to engage in hypothesis-driven experimentation and analytical thinking.

2. Place studies (and researchers) within the larger field of biology.
   This skill requires students to:
   - Identify appropriate information sources
   - Comprehend and critically analyze primary and secondary literature
   - Distinguish between supported and unsupported conclusions in a given study
   These activities will result in a deeper and nuanced understanding of a biological study, its relationship to prior published work, and the formulation of future directions for the field.
**LEARNING OUTCOMES (GAP ANALYSIS)**

<table>
<thead>
<tr>
<th>Tier Course</th>
<th>Tier I</th>
<th>Tier II</th>
<th>Tier III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply the scientific process to address biological questions and problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Make observations</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. Identify significant open questions</td>
<td>X</td>
<td>X</td>
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<tr>
<td>3. Formulate hypotheses</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>4. Design experiments</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>5. Learn modern laboratory techniques</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>6. Collect and document data</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>7. Analyze, interpret, and present data</td>
<td>X</td>
<td>X</td>
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<tr>
<td>8. Collaborate with others to solve problems</td>
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<td>10. Comprehend and critically analyze primary and secondary literature</td>
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<td>X</td>
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</tbody>
</table>
ASSIGNMENTS
MODEL EXERCISES AND PRINCIPLES OF DESIGN

PRINCIPLES OF ASSIGNMENT DESIGN

Authentic
Motivate students by asking them to address real-world problems or questions.

Iterative
Foster growth by allowing students to explore, revise, and reflect; provide ample time and feedback for each stage.

Context
Enhance understanding of course material by asking students to make new connections between the literature and course topics.

Process-based
Improve student work by creating sequential assignments that mirror the research process instead of emphasizing the final product.
COURSE LEVEL ASSESSMENT

Freshmen

Sophomores

Juniors

Seniors
## COURSE LEVEL ASSESSMENT

<table>
<thead>
<tr>
<th>Name</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Introduction/Background</td>
<td>Does not introduce the problem, question, or topic (0-1 pts)</td>
<td>Introduces the problem, question, or topic, but not in a way that clearly explains its importance (2-3 pts)</td>
<td>Introduces the problem, question, or topic in a way that clearly explains its importance (3-4 pts)</td>
<td></td>
</tr>
<tr>
<td>B. Current Research</td>
<td>No analysis of the current research (0-2 pts)</td>
<td>Some analysis of the current research, but limited understanding of connections between studies (3-4 pts)</td>
<td>Substantial analysis that shows understanding of connections between studies (5-6 pts)</td>
<td></td>
</tr>
<tr>
<td>C. Perspective</td>
<td>No perspective offered; or perspective offered is brief and/or vague (0-1 pts)</td>
<td>Perspective offered, but does not demonstrate understanding of research (1-4 pts)</td>
<td>Perspective offered that demonstrates understanding of research (5-6 pts)</td>
<td></td>
</tr>
<tr>
<td>D. Literature Cited (Accuracy)</td>
<td>Cited sources could not be retrieved (0-1 pts)</td>
<td>Cited sources might be retrieved by reader, but only with some difficulty (2 pts)</td>
<td>Cited sources could be easily retrieved by reader (3 pts)</td>
<td></td>
</tr>
<tr>
<td>E. Molecular Content</td>
<td>Content is not related to molecular or cell biology (0-1 pts)</td>
<td>Content is related, but does not include detailed discussion of molecular or cell biology aspects (2 pts)</td>
<td>Content includes detailed discussion of molecular or cell biology aspects (3 pts)</td>
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</tr>
<tr>
<td>A. Overall Quality of Effort (0-3 pts)</td>
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</tbody>
</table>
# PROGRAM ASSESSMENT

## Mapping Courses to Biology Program Goals

<table>
<thead>
<tr>
<th>Tier Course</th>
<th>Tier I L112</th>
<th>Tier II L211</th>
<th>Tier III L312</th>
<th>Tier III M360</th>
<th>Tier III B371</th>
<th>Tier III L322</th>
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<tr>
<td><strong>Apply the scientific process to address biological questions and problems</strong></td>
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<td>1. Make observations</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Identify significant open questions</td>
<td>X</td>
<td>X</td>
<td></td>
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<td>3. Formulate hypotheses</td>
<td>X</td>
<td>X</td>
<td></td>
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<td>4. Design experiments</td>
<td>X</td>
<td>X</td>
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<tr>
<td>5. Learn modern laboratory techniques</td>
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<td>X</td>
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<tr>
<td>6. Collect and document data</td>
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<td></td>
<td>X</td>
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<tr>
<td>7. Analyze, interpret, and present data</td>
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<td>9. Identify appropriate information sources</td>
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<td>X</td>
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<td></td>
<td>X</td>
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<td>10. Comprehend and critically analyze primary and secondary literature</td>
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</tbody>
</table>
PROGRESS (SO FAR)

• Increased buy-in
• The “what librarian” experience
• Program-level awareness

TRANSFERABILITY AT IU

• Chemistry (easy)
• University Archives/Wylie House (weird)
• Painting Class (no way!)
TRANSFERABILITY BEYOND IU

- “SEAS” not necessary or possible everywhere
- Model should make sense in any program that is sequential
- ILIAD: “Give us a way to share.”

FUTURE WORK

- Implement in more programs at IU
- Longitudinal assessment
- Multi-institutional partnerships
- ILIAD: study librarian/instructor interaction, evolution of materials, etc.
THANKS! QUESTIONS?