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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INTRODUCTION AND ASSESSMENT OF INFORMATION LITERACY IN AN UNDERGRADUATE BIOLOGY PROGRAM

A Sustainable and Transferrable Model

Brian Winterman
Indiana University Libraries
bwinterm@indiana.edu
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
L111/L112
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
L211/M250
News and Views
• Personal position addressed to general audience
• Variety of info used
• Comprehend and explain

TIER 3
300’s/400’s
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 I: Foundations

The primary focus of Tier I is to develop a foundational understanding of the scientific method and critical thinking skills. Students will learn how to identify and evaluate scientific claims, assess evidence, and communicate their understanding of scientific concepts.

LEARNING OUTCOMES

These learning outcomes were designed to describe the competencies that are needed for successful completion of Tier I. They are based on the following principles:

1. Identify and define a question or argument that can be addressed using scientific methods.
2. Use data and evidence to support claims and conclusions.
3. Develop critical thinking skills through the analysis of scientific literature.

The student will:

1. Identify and define a question or argument that can be addressed using scientific methods.
2. Use data and evidence to support claims and conclusions.
3. Develop critical thinking skills through the analysis of scientific literature.
4. Evaluate the validity of scientific claims and arguments.

Examples of Tier I Assignments:

- A short paper discussing the scientific method and its application in a specific field.
- A critical review of a scientific article, focusing on the methodology and conclusions.

Tier II: Perspectives

The primary focus of Tier II is to develop a more comprehensive understanding of the scientific method and its application in real-world scenarios. Students will learn how to apply scientific principles to solve complex problems and make informed decisions.

LEARNING OUTCOMES

These learning outcomes were designed to describe the competencies that are needed for successful completion of Tier II. They are based on the following principles:

1. Identify and define a question or argument that can be addressed using scientific methods.
2. Use data and evidence to support claims and conclusions.
3. Develop critical thinking skills through the analysis of scientific literature.
4. Evaluate the validity of scientific claims and arguments.

The student will:

1. Identify and define a question or argument that can be addressed using scientific methods.
2. Use data and evidence to support claims and conclusions.
3. Develop critical thinking skills through the analysis of scientific literature.
4. Evaluate the validity of scientific claims and arguments.
5. Synthesize information from multiple resources to support a claim or observation.
6. Represent information from different sources in an accurate and comprehensive manner.
7. Cite sources consistently and accurately.

Examples of Tier II Assignments:

- A short paper discussing the scientific method and its application in a specific field.
- A critical review of a scientific article, focusing on the methodology and conclusions.

Tier III: Innovations

The primary focus of Tier III is to develop a comprehensive understanding of the scientific method and its application in real-world scenarios. Students will learn how to apply scientific principles to solve complex problems and make informed decisions.

LEARNING OUTCOMES

These learning outcomes were designed to describe the competencies that are needed for successful completion of Tier III. They are based on the following principles:

1. Identify and define a question or argument that can be addressed using scientific methods.
2. Use data and evidence to support claims and conclusions.
3. Develop critical thinking skills through the analysis of scientific literature.
4. Evaluate the validity of scientific claims and arguments.

The student will:

1. Identify and define a question or argument that can be addressed using scientific methods.
2. Use data and evidence to support claims and conclusions.
3. Develop critical thinking skills through the analysis of scientific literature.
4. Evaluate the validity of scientific claims and arguments.
5. Synthesize information from multiple resources to support a claim or observation.
6. Represent information from different sources in an accurate and comprehensive manner.
7. Cite sources consistently and accurately.

Examples of Tier III Assignments:

- A short paper discussing the scientific method and its application in a specific field.
- A critical review of a scientific article, focusing on the methodology and conclusions.
<table>
<thead>
<tr>
<th>Tier I: Relevance to course/ NATURE AND STRUCTURE</th>
<th>Tier II: 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.) / “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 or gap in knowledge. Identify the societal implications of research. (outline)</td>
</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>
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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>
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</tr>
<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>
</tr>
<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>
</tr>
</tbody>
</table>
| 6. Summarize information from primary and secondary literature | 6. Synthesizes information from multiple resources to provide perspective on a topic | 6. Synthesizes information from multiple resources to construct an argument for proposed solutions /
| 7. Citations sources including recognizing when an idea is common knowledge | 7. Citations original source of information to support claim or observation; Accurate portrayal of others conclusions | 7. Citations original source of information to support claim or observation; Accurate portrayal of other conclusions /
<p>| 8. Quotes and paraphrases and attributes accurately and appropriately | 8. Quotes and paraphrases and attributes accurately and appropriately | 8. Quotes and paraphrases and attributes accurately and appropriately |
| 9. Interprets a figure from literature in the context of the study. | 9. Interprets a figure from literature in the context of the study. | 10. Interprets a figure from literature in the context of the study. |
| 10. Citations sources including recognizing when an idea is common knowledge | 10. Citations original source of information to support claim or observation. Accurately portrays the findings/conclusions of cited papers. | 11. Citations original source of information to support claim or observation. Accurately portrays the findings/conclusions of cited papers. |
| 11. Attributes quotations and paraphrased information in an accurate and appropriate manner. | 11. Attributes quotations and paraphrased information in an accurate and appropriate manner. | 12. Attributes quotations and paraphrased information in an accurate and appropriate manner. |
| a. Poor: Plagiarizes | a. Less reliance on quotations (should be synthesizing!) | a. Less reliance on quotations (should be synthesizing!) |
| b. Good: Citations in (author, date) format | b. One issue I can see with this is how we can observe this without doing a LOT of extra work? | b. One issue I can see with this is how we can observe this without doing a LOT of extra work? |
| c. Excellent: Citations sources only when needed (not for common knowledge info) | c. Maybe don’t need # 9? | c. Maybe don’t need # 9? |</p>
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2. Summarizes the information available in different types of sources (primary, secondary, etc) and makes explicit connections among these sources
3. Uses appropriate tools (indexes, catalogs, etc.) to access sources
4. Identifies the sections of a primary research article and their purpose
5. Describes the general methodological and the logic of the study
6. Summarizes information from primary and secondary literature
7. Cites sources including recognizing when an idea is commonly known
8. Quotes and paraphrases and attributes accurately and appropriately
9. Interprets a figure from literature in the context of the study

---
LEARNING OUTCOMES (GAP ANALYSIS)

Students graduating from our program will be able to:

1. Apply the scientific methodology to address biological questions and problems.
   - 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 practice hypothesis-driven experimentation and analytical thinking.

2. Place studies in appropriate historical and broader contexts within the larger field of biological research.
   - 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.
Mapping Courses to Biology Program Goals

<table>
<thead>
<tr>
<th>Tier</th>
<th>Course</th>
<th>Tier I</th>
<th>Tier II</th>
<th>Tier III</th>
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<tr>
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<td>Apply the scientific process to address biological questions and problems</td>
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<td>X</td>
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<td></td>
</tr>
<tr>
<td>2.</td>
<td>Identify significant open questions</td>
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<td>Analyze, interpret, and present data</td>
<td>X</td>
<td>X</td>
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<td>Collaborate with others to solve problems</td>
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<td>Comprehend and critically analyze primary and secondary literature</td>
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<td>X</td>
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<tr>
<td>11.</td>
<td>Distinguish between supported and unsupported conclusions</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
ASSIGNMENTS
MODEL EXERCISES AND PRINCIPLES OF DESIGN

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

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

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

- **Iterative**
  Foster growth by allowing students to explore, revise, and reflect; provide ample time and feedback for each stage.
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><strong>A. Introduction/Background</strong></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><strong>B. Current Research</strong></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 (1-4 pts)</td>
<td>Substantial analysis that shows understanding of connections between studies (5-6 pts)</td>
<td></td>
</tr>
<tr>
<td><strong>C. Perspective</strong></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><strong>D. Literature Cited (Accuracy)</strong></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><strong>E. Molecular Content</strong></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>
<td></td>
</tr>
<tr>
<td><strong>A. Overall Quality of Effort (0-3 pts)</strong></td>
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</table>
## Mapping Courses to Biology Program Goals

<table>
<thead>
<tr>
<th>Tier Course</th>
<th>Tier I</th>
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<tbody>
<tr>
<td>Apply the scientific process to address biological questions and problems</td>
<td>L112</td>
<td>L211</td>
<td>L312</td>
</tr>
<tr>
<td>1. Make observations</td>
<td></td>
<td></td>
<td>X</td>
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</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?