BACKGROUND

• NETI-I IN JANUARY 2016

• MICHAEL PRINCE AND RICHARD FELDER: RESEARCH IN INDUCTIVE LEARNING

• MY TEACHING CHALLENGE:

I EXPLAINED EVERYTHING VERY WELL AND CLEAR. WHY STUDENTS DID NOT UNDERSTAND AND PREFORM POORLY ON TESTS?

• THE ANSWER WAS: BECAUSE I DID NOT KNOW HOW STUDENTS LEARN!
CONSTRUCTIVISM IN TEACHING AND LEARNING

People construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences.

When we encounter something new, we have to reconcile it with our previous ideas and experience.
AN EXAMPLE

• A CHILD BELIEVES THAT THE EARTH IS FLAT
  – BASED ON WHAT S/HE SEES AND FEELS

• A TEACHER SAYS TO THE CHILD THAT THE EARTH IS ROUND

• THE CHILD CONNECTS THIS NEW PIECE OF KNOWLEDGE TO HIS/HER BELIEVES AND PREVIOUS KNOWLEDGE

• THE RESULT OF THE LESSON IS:
AN EXAMPLE: LEARNING OUTCOMES

The Earth is like a pancake: flat and round!
**WHAT HAPPENS WHEN A STUDENT GETS A NEW PIECE OF INFORMATION?**

The student compares the information to the knowledge and understanding he/she already has, and one of the following can occur:

<table>
<thead>
<tr>
<th>The new information matches up with his previous knowledge well</th>
<th>The student <strong>adds</strong> it to their understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The information doesn't match previous knowledge</strong></td>
<td>The student has to <strong>change</strong> her previous understanding to find a fit for the information</td>
</tr>
<tr>
<td></td>
<td>The new information is <strong>ignored</strong>:</td>
</tr>
<tr>
<td></td>
<td>• Rejected bits of information may just not be absorbed by the student.</td>
</tr>
<tr>
<td></td>
<td>• Or they may float around until the student's understanding has developed and permits a fit</td>
</tr>
</tbody>
</table>
DEDUCTIVE VS. INDUCTIVE APPROACHES

DEDUCTIVE (TRADITIONAL)

FUNDAMENTALS (SCIENTIFIC PRINCIPLES, ANALYTICAL METHODS) → DERIVATIONS → EXAMPLES → HOMEWORK, LABS, PROJECTS

INDUCTIVE (INCURY, PROBLEM-BASED LEARNING)

CHALLENGES (QUESTIONS, PROBLEMS, OBSERVATIONS, DATA) → DEFINE PROBLEMS, NEEDS → INSTRUCTION (PRINCIPLES, METHODS) → FIND/REFINE SOLUTION
### Features of Common Inductive Instructional Methods (Prince & Felder, 2006)

<table>
<thead>
<tr>
<th>Method Feature</th>
<th>Inquiry</th>
<th>Problem-based</th>
<th>Project-based</th>
<th>Case-based</th>
<th>Discovery</th>
<th>JITT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions or problems provide context for learning</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Complex, ill-structured, open-ended real-world problems provide context for learning</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Major projects provide context for learning</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Case studies provide context for learning</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Students discover course content for themselves</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Students complete &amp; submit conceptual exercises electronically; instructor adjusts lessons according to their responses</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Primarily self-directed learning</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>4</td>
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<tr>
<td>Active learning</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Collaborative/cooperative (team-based) learning</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

1 – by definition, 2 – always, 3 – usually, 4 – possibly
EXAMPLE: INVENTORY COST AND EOQ CONCEPTS

EOQ Model Equations

Optimal Order Quantity: \( Q^* = \sqrt{\frac{2 \cdot D \cdot S}{H}} \)

Expected Number Orders: \( N = \frac{D}{Q^*} \)

Expected Time Between Orders: \( T = \frac{\text{Working Days / Year}}{N} \)

\[ d = \frac{D}{\text{Working Days / Year}} \]

\[ ROP = d \cdot L \]

- \( D = \text{Demand per year} \)
- \( S = \text{Setup (order) cost per order} \)
- \( H = \text{Holding (carrying) cost} \)
- \( d = \text{Demand per day} \)
- \( L = \text{Lead time in days} \)
## AN EXAMPLE: INDUCTIVE APPROACH

1) **DISCUSSION:** STUDENTS SHARE THEIR KNOWLEDGE AND UNDERSTANDING OF INVENTORY COST

2) **CASE STUDY:** WHO IS RIGHT, THE PRODUCTION MANAGER OR PROCUREMENT MANAGER?

<table>
<thead>
<tr>
<th>Quantity</th>
<th># of Cases</th>
<th>Orders Per year</th>
<th>Annual Ordering Cost</th>
<th>Average Inventory</th>
<th>Annual Holding Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>2</td>
<td>358.40</td>
<td>17203.20</td>
<td>15</td>
<td>537.6</td>
<td>17740.80</td>
</tr>
<tr>
<td>60</td>
<td>4</td>
<td>179.20</td>
<td>8601.60</td>
<td>30</td>
<td>1075.2</td>
<td>9676.80</td>
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<tr>
<td>90</td>
<td>6</td>
<td>119.47</td>
<td>5734.40</td>
<td>45</td>
<td>1612.8</td>
<td>7347.20</td>
</tr>
<tr>
<td>120</td>
<td>8</td>
<td>89.60</td>
<td>4300.80</td>
<td>60</td>
<td>2150.4</td>
<td>6451.20</td>
</tr>
<tr>
<td>150</td>
<td>10</td>
<td>71.68</td>
<td>3440.64</td>
<td>75</td>
<td>2688</td>
<td>6128.64</td>
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<tr>
<td>165</td>
<td>11</td>
<td>65.16</td>
<td>3127.85</td>
<td>82.5</td>
<td>2956.8</td>
<td>6084.65</td>
</tr>
<tr>
<td>169.71</td>
<td>11.31</td>
<td>63.36</td>
<td>3041.12</td>
<td>84.85</td>
<td>3041.12</td>
<td>6082.25</td>
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<tr>
<td>180</td>
<td>12</td>
<td>59.73</td>
<td>2867.20</td>
<td>90</td>
<td>3225.6</td>
<td>6092.80</td>
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<tr>
<td>195</td>
<td>13</td>
<td>55.14</td>
<td>2646.65</td>
<td>97.5</td>
<td>3494.4</td>
<td>6141.05</td>
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<tr>
<td>240</td>
<td>16</td>
<td>44.80</td>
<td>2150.40</td>
<td>120</td>
<td>4300.8</td>
<td>6451.20</td>
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<tr>
<td>480</td>
<td>32</td>
<td>22.40</td>
<td>1075.20</td>
<td>240</td>
<td>8601.60</td>
<td>9676.80</td>
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<td>960</td>
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AN EXAMPLE: INDUCTIVE APPROACH

3) ONLINE GAME: PLACE ORDERS FOR A PRODUCT FOR A RETAIL STORE TO MINIMIZE INVENTORY COST

You incur three types of costs:

1. **Holding Cost** - A charge for storing inventory, assessed per unit per week.
2. **Ordering Cost** - A flat fee for placing an order, regardless of how many units you order. If your order quantity is zero, there is no ordering cost. Ordering cost is assessed in the week when delivery occurs.
3. **Stockout Penalty** - If you run out of inventory and cannot meet customer demand in any given week, you will receive a stockout penalty for that week. Stockout penalties tend to be very high, so try to avoid stockouts.
AN EXAMPLE: INDUCTIVE APPROACH

4) STUDENTS SELF-REFLECTION: WHAT DID YOU LEARN?
ROLE OF TEACHER IN INDUCTIVE LEARNING

TEACHERS HELP STUDENTS TO CONSTRUCT KNOWLEDGE RATHER THAN TO REPRODUCE A SERIES OF FACTS:

• ENCOURAGES STUDENTS TO USE ACTIVE TECHNIQUES (EXPERIMENTS, REAL-WORLD PROBLEM SOLVING) TO CREATE MORE KNOWLEDGE

• ENCOURAGES TO REFLECT ON WHAT THEY ARE DOING AND HOW THEIR UNDERSTANDING IS CHANGING

• HAS TO UNDERSTANDS THE STUDENTS’ PREEXISTING CONCEPTIONS

• GUIDES THE ACTIVITY TO ADDRESS THE PREEXISTING CONCEPTIONS AND THEN BUILD ON THEM.

GUIDED BY THE TEACHER, STUDENTS CONSTRUCT THEIR KNOWLEDGE ACTIVELY RATHER THAN JUST MECHANICALLY INGESTING KNOWLEDGE FROM THE TEACHER
SUMMARY

PROS OF INDUCTIVE TEACHING (BASED ON RESEARCH):

• LONG-TERM RETENTION
• TRANSFER OF KNOWLEDGE
• CONCEPTUAL UNDERSTANDING AND CONNECTIONS
• DEEP APPROACH TO LEARNING
• POSITIVE STUDENTS ATTITUDE

CONS OF INDUCTIVE TEACHING:

• MAY REQUIRE MORE PREPARATION TIME
• INVOLVES LEARNING CURVE
• MAY EVOKE STUDENTS RESISTANCE (PBL PUSHES STUDENTS OUT OF THEIR COMFORT ZONE)
SOURCES


• PICTURES:

  • HTTPS://EN.WIKIPEDIA.ORG/WIKI/CHILD_DEVELOPMENT
  • HTTP://WWW.THINKLAW.US/5-WAYS-TO-ENCOURAGE-CRITICAL-THINKING-WITH-YOUR-TODDLER/
  • HTTP://WWW.THIRTEEN.ORG/EDONLINE/CONCEPT2CLASS/CONSTRUCTIVISM/EXPLORATION.HTML