Creation of a Problem-Based Learning Categorization Matrix

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Problem Statement

- Lack of consensus in PBL definitions
- Variation in PBL implementation
- Variation in problems
- Lack of empirical testing
- Lack of comparison of problem type within PBL

Definition of PBL and Universal Characteristics

Definition:

- "Focused, experiential learning organized around the investigation and resolution of messy, real-world problems" (Torp and Sage 2002, as seen in Savery, 2006 p. 12).

Characteristics:

1. Use of ill-structured problems;
2. Student-centered approach where the students determine what needs to be learned rather than the instructor;
3. Instructors as facilitators, guiding learning; and
4. Authentic problems.

Barrows' (1986) Problem-Based Learning Taxonomy

1. Lecture-Based Cases
   - Teacher lectures first and presents a case to demonstrate content second
2. Case-Based Lectures
   - Case is presented first followed by lecture on content
3. Case Method
   - A complete case is used to present content
   - Case is synthesized and organized for students
4. Modified Case-Based
   - Guided inquiry or structured problems based on the complete case
5. Problem-Based
   - Simulation of an authentic problem allowing for "free inquiry"
6. Closed-Loop Problem-Based
   - Presentation of an authentic problem
   - Self-directed learning for content followed by student evaluation of resources
   - Students revisit the problem and reflect on their problem solving process

Scoring of Barrows' Taxonomy

	SCC	CRP	SDL	MOT	Total Score
Lecture-Based Cases	1	1	0	1	3
Case-Based Lectures	2	2	0	2	6
Case Method	3	3	3	4	13
Modified Case-Based	4	3	3	5	15
Problem-Based	4	4	4	5	17
Closed-Loop Problem-Based	5	5	5	5	20

Jonassen's Problem Type

1. Story Problems
   - Well-structured, shallow context, all information needed contained in problem
2. Rule-Using Problems
   - One correct solution, but multiple paths can be taken to get there
3. Decision-Making Problems
   - Require choice in action
4. Troubleshooting Problems
   - Require diagnosis or troubleshooting a faulty system

Jonassen's Problem Type Continued

5. Strategic Performance Problems
   - Real-time situations requiring tactical solutions to problems under a time pressure
6. Policy Problems
   - Multiple issues and perspectives in one problem
7. Design Problems
   - Application of domain and strategic knowledge to create a design to solve a problem
8. Dilemmas
   - Most ill-structured
   - No clear solution or no solution deemed acceptable to everyone

Matrix Development

A combination of the categorization of problem type (Jonassen) and taxonomy (Barrows)

- X Axis: Problem types (8) forming a highly-structured to ill-structured continuum. Utilizes a scale from 1-8 increasing with lack of structure

- Y Axis: Taxonomy categories (6) forming a continuum reflecting increasingly self-directed and authentic learning activities

   - Taxonomy axis reflects the amount to which each type of learning meets the four educational objectives. Leads to a total impact on educational objective score applied to each of the six categories.

Matrix Characteristics

- Forms a scaled variable of total PBL environment.
  - Total taxonomy type score from six categories
  - Total problem type from eight types

- Forms 48 type/taxonomy combinations for potential scoring

- One course PBL activity score ranges from 3 to 160
  - Matrix is built to mathematically favor the intensity of the PBL experience in forming a continuous scale which can be used for research or curricular review/planning

Coding Process

- Identify the unit of review
  - Curriculum broken into courses, course becomes the unit for example.
- PBLE is scored using the matrix for each unit of review
- Gather data on each reviewed unit
  - All available materials used to develop the course and used in the course
    - Syllabus
    - Course Binder/documentation
    - Course Artifacts
      - Lecture notes, powerpoint slides, transparencies, readings, quizzes, exams, example problems, homework projects, cases, etc.

Coding Steps

1. Place a tick mark in the appropriate cell each time an example of PBL environment is identified (from any course artifact)
2. Score each tick mark multiplying the problem type and PBL taxonomy score for each cell.
3. Average all of the cell scores by row and column.
4. Average total taxonomy & total problem type to create a total PBLE score for the course.

Matrix Utilization

- Research
  - Provides a total PBLE continuous scaled score for use in correlation or regression and as a potential dependent variable in group comparative studies.
  - Research may identify categorical levels of total PBLE (e.g. high, medium, low) for use in group comparative studies.
- Curriculum Review/Revision
  - Identification of overall level of PBL in courses and across a curriculum.
  - Assists in judging the relative contribution of courses to curricular PBLE.
  - Allows evaluation on relative contribution to PBLE of both problem types and taxonomy categories.

Results To Date – One Engineering Department

	PBLE	PBL	Ptype
Mean	49.91	7.72	3.03
Standard Deviation	57.52	8.26	3.13
Range	156	20	7.5
Minimum	0	0	0
Maximum	156	20	7.5

Coding Activity

- Materials:
  - Civil Engineering Dynamics Challenge Problem
  - Problem-Based Learning Curriculum Matrix
- Activity:
  - Audience applies PBL matrix to the challenge problem
  - Discuss results they found
- Presentation of results

PBL Curriculum Matrix – CE Dynamics

Jonassen's Problem Type

Barrow's PBL Taxonomy		Story Problems (1)	Rule-Using Problems (2)	Decision-Making Problems (3)	Troubleshooting Problems (4)	Strategic Performance Problems (5)	Policy Problems (6)	Design Problems (7)	Dilemmas (8)	Total Taxonomy Type
	Lecture-Based Cases (3)									
	Case-Based Lecture (6)									
	Case Method (13)			‖‖ 13×3 = 39 39×4 = ⑯						13
	Modified case-Based (15)									
	Problem-Based (17)									
	Closed-Loop Problem Based (20)									
	Total Problem Type			3						156

Questions?

References

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