Epistemic Analysis of Common Exam Questions Across Course Formats

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Course Formats

Lecture+lab - **(LL)** - with 85 total students, reflect a classic learning environment where students receive the majority of their instruction straight from the board.

Inquiry Based- **(IQB)** -(Modeling & ISLE) - with 91 students total, are studio classroom learning environments where students engage in white boarding sessions, small group activities.

Lecture+lab+Recitation- **(LLR)** - with 117 students (one section), takes half the lecture time of the LL and uses it for recitation sections run by teaching assistants and learning assistants.

Epistemic Forms/Games [1,2]

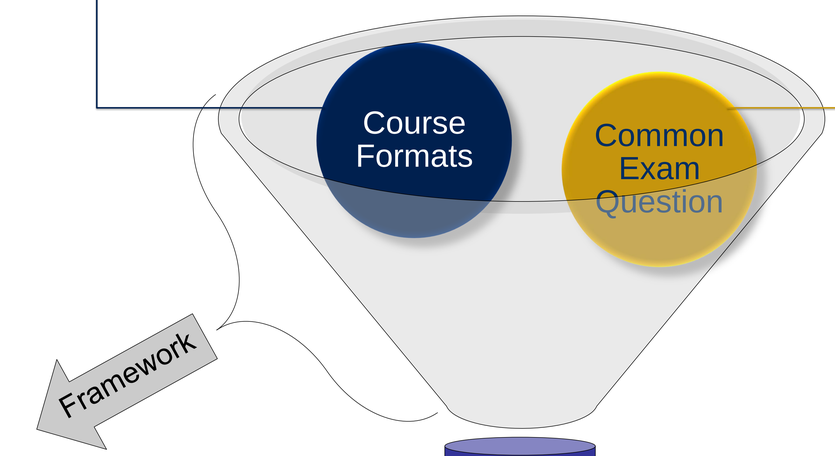
Epistemic Forms[1]
- how knowledge can be organized
- how concepts can be learned

Generated by students when creating their answer

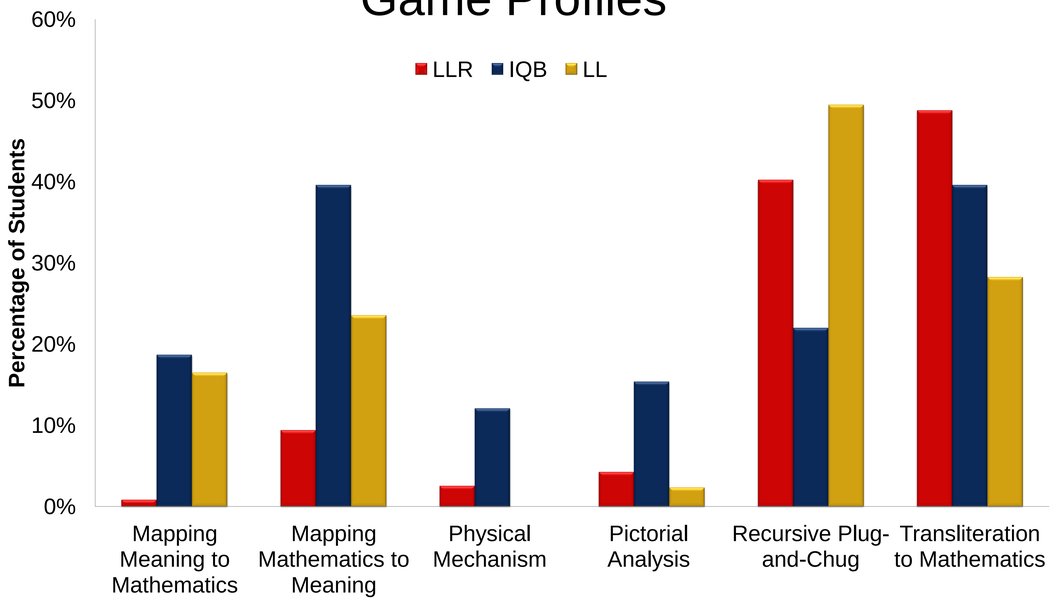
Epistemic Games[2]
– rules and strategies that guide inquiry
- Forms are created via games

Six Epistemic Games

#	Game	Short Discription
1	Mapping Meaning to Mathematics	Students begin from a conceptual understanding of the physical situation
2	Mapping Mathematics to Meaning	Students develop a conceptual story corresponding to a particular physics equation
3	Physical Mechanism	Students attempt to construct a physically coherent and descriptive story
4	Pictorial Analysis	Students generate an external spatial representation
5	Recursive Plug-and-Chug	Students plug quantities into physics equations and churn out numeric answers, without conceptually understanding
6	Transliteration to Mathematics	Students often use worked examples to develop solutions



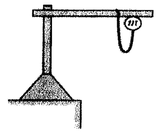
Game Profiles



Percentage of students that played multiple games		
LLR	**IQB**	**LL**
7%	40%	26%

Common Exam Question

Subpart



The student now attached an object of unknown mass m to the cord and holds the object adjacent to the point at which the top of the cord is tied to the rod, as represented above. When the object is released from rest, it falls 1.5 m before stopping and turning around. Assume that air resistance is negligible.

Question: Calculate the value of the unknown mass m of the object.

Rubric

- Applied epistemic games to question written responses
- Playing 50% of a game equated game played
- Inter-rater reliability (two graders) tested on 30 randomly selected students from pool
- Correlation reported an R value of 0.93

Take Away

- Epistemic games can be applied to student written responses
- LLR students showed evidence of single game usage between games 5 & 6
- IQB students have greatest facility with multiple games dominance in games 2 & 6
- LL students show facility with multiple games with heavy usage of game 5
- Facility with multiple games may indicate expertise (future work pending)

References

1. Collins, Allan, and William Ferguson. "Epistemic forms and epistemic games: Structures and strategies to guide inquiry." *Educational Psychologist* 28.1 (1993): 25-42.
2. Tuminaro, Jonathan, and Edward F. Redish. "Elements of a cognitive model of physics problem solving: Epistemic games." *Physical Review Special Topics-Physics Education Research* 3.2 (2007): 020101.