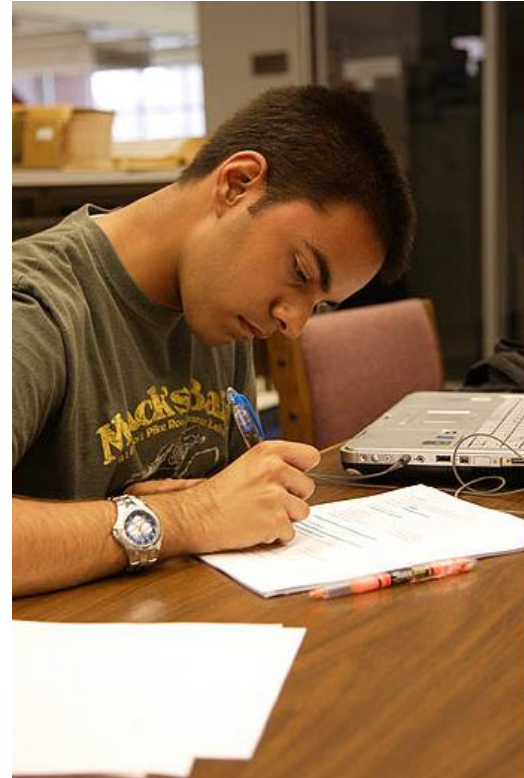


Automated Text Analysis Facilitates
Using Written Formative
Assessments for Just-in-Time
Teaching in Large Enrollment
Courses

Assessment to Reveal Student Thinking



- Large enrollment courses prohibit the use of constructed response assessments

Constructed response assessments

- Allow students to represent their understanding in their own words (Keuchler and Simpkin 2010)
- Give faculty greater insight into student thinking compared to multiple choice assessments (Birenbaum, and Tatsuoka 1987)
- Students treat CR and multiple- choice assessments as different cognitive tasks and prepare for them differently (Stanger-Hall 2012)

Study Population

- 3 sections of Introductory Biology Cell and Molecular Course for Majors
- 4 instructors

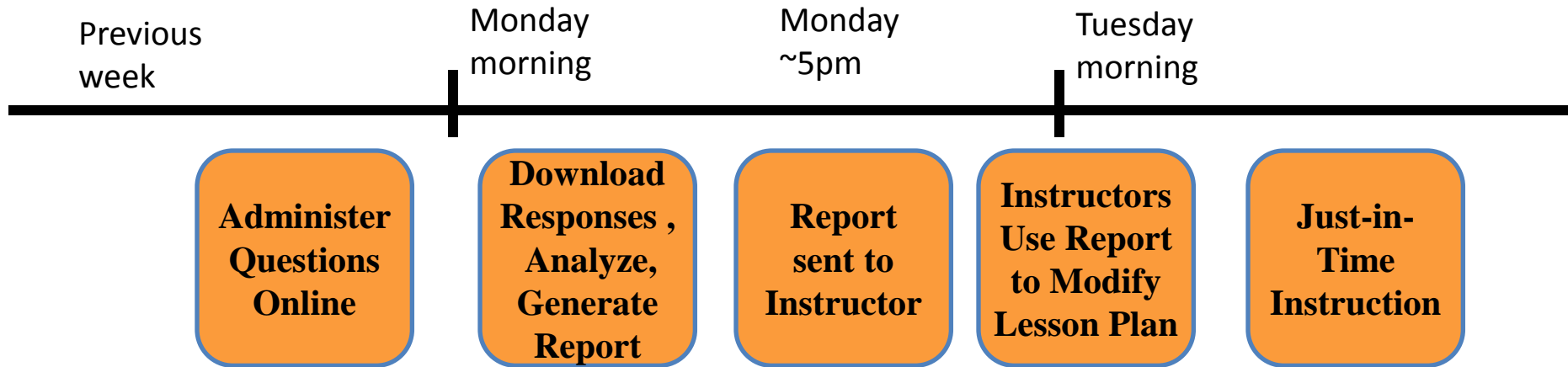
	Section 1	Section 2	Section 3
Enrollment	309	466	302
% Female	46	58	49
% First and second years	69	69	67
Cum GPA at start of term	2.48	2.69	2.52

Scope of Analysis

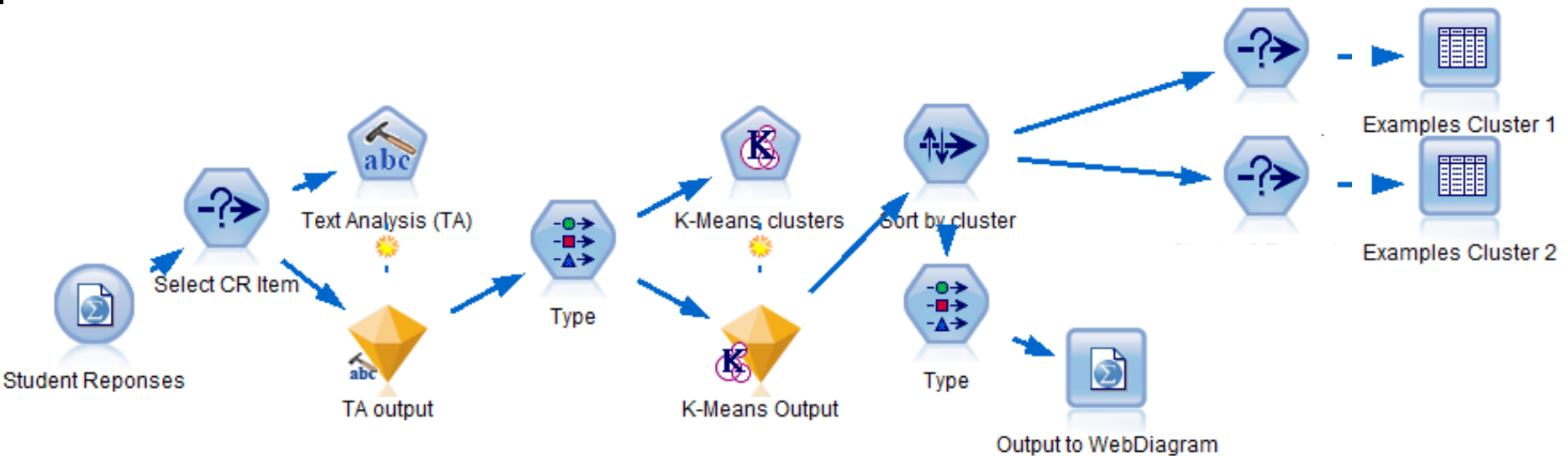
- 15 questions
 - Thermodynamics, acid-base chemistry, metabolism, genetics
- Responses collected

Pre	Post	Total
8,290	4,387	12,677

Timeline: Feedback Report and Just-in-Time Teaching



Analysis Stream in IBM SPSS Modeler



- Connects text and cluster analyses
- Generates output for feedback report
- Allows rapid analysis of new data sets

Build		Extend		Display	
Category		Docs			
All Documents		129		Carbohydrate (129)	
Uncategorized		0		2	
No concepts extracted		0		3	
break		113		4	
bond		99		5	
room temperature		78		6	
reaction		71		7	
energy		50		8	
sugar		44			
covalent bond		42			
covalent bond		30			
covalently		9			
covalent		4			
covalent bond of the starch		0			
covalent chemical bond		0			
covalent bond stay		0			
heat		41			
require		40			
high		38			
fast		25			
spontaneous		21			
speed		18			
catalyst enzyme		16			
molecule		13			
process		12			
water		8			
not sufficient		8			

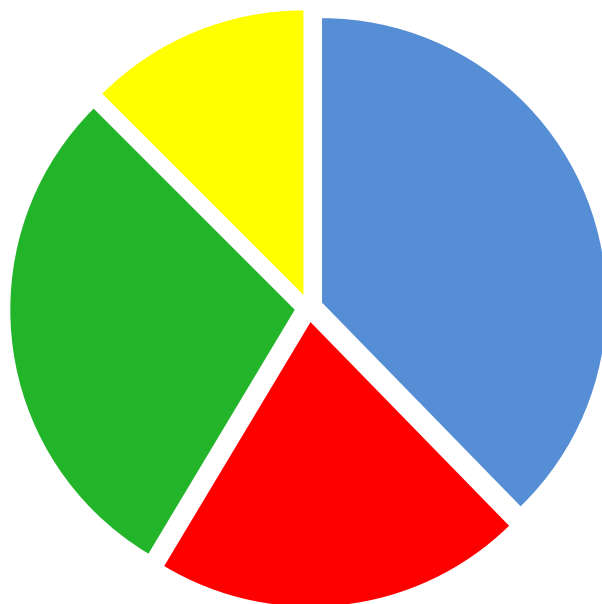
Categories	
bond	
bond break energy	
bond break room temperature sugar	
break bond sugar room temperature	
bond break reaction covalent bond	
bond break covalent bond	
bond break reaction heat	
reaction room temperature	

Question

A carbohydrate is composed of a string of covalently linked monosaccharides. Breaking those bonds between the monosaccharides is a chemically spontaneous reaction (ΔG for this reaction is -3.7 kcal/mol). However, this reaction occurs very slowly at room temperature.

Why do you think this is so?

Feedback Report



- Miscellaneous
- High temperatures/
Activation Energy
- Energy to Break
Bond
- High Temperature to
Break Bonds

Miscellaneous	High temperatures/ Activation Energy	Energy to Break Bond	High Temperature to Break Bonds
37.7%	20.9%	28.9%	12.5%
This reaction occurs very slowly at room temperature because the reaction is only - 3.7 kcal/mol which is a low reaction.	The activation energy is higher at room temperature so it takes longer for the reaction to proceed	because it takes alot of energy to break these bonds.	The reaction occurs slowly at room temperature because the kinetic energy of the atoms is very low. As you increase the temperature the kinetic energy rises which allows for the atoms to move more quickly and then break apart from each other.

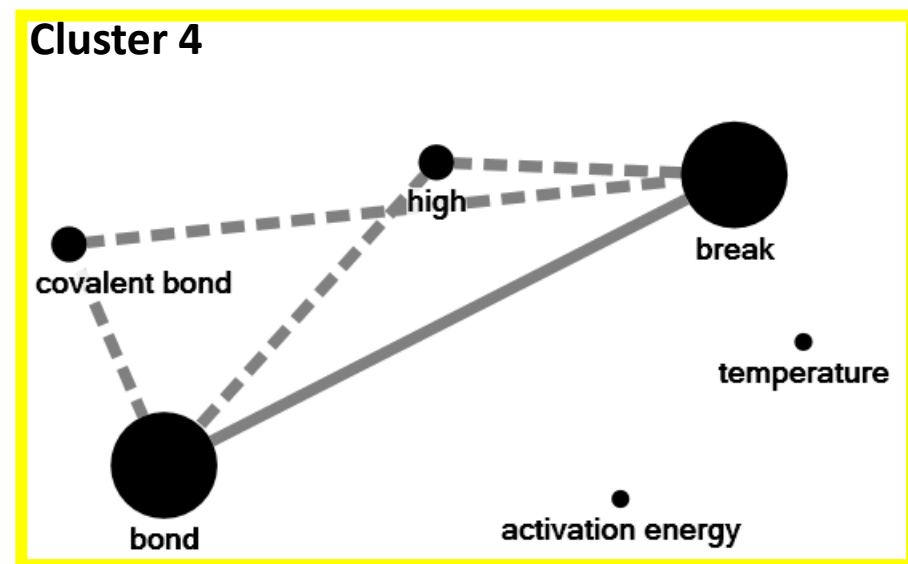
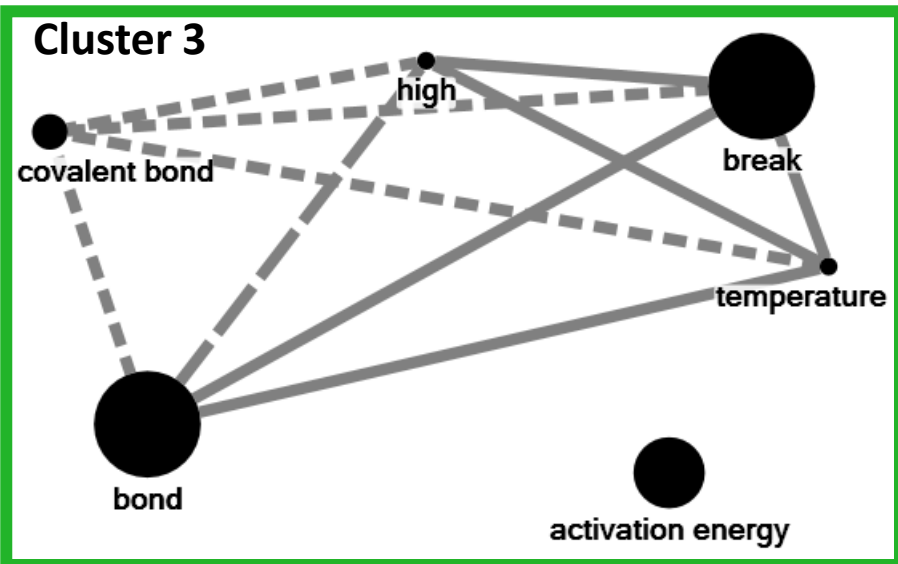
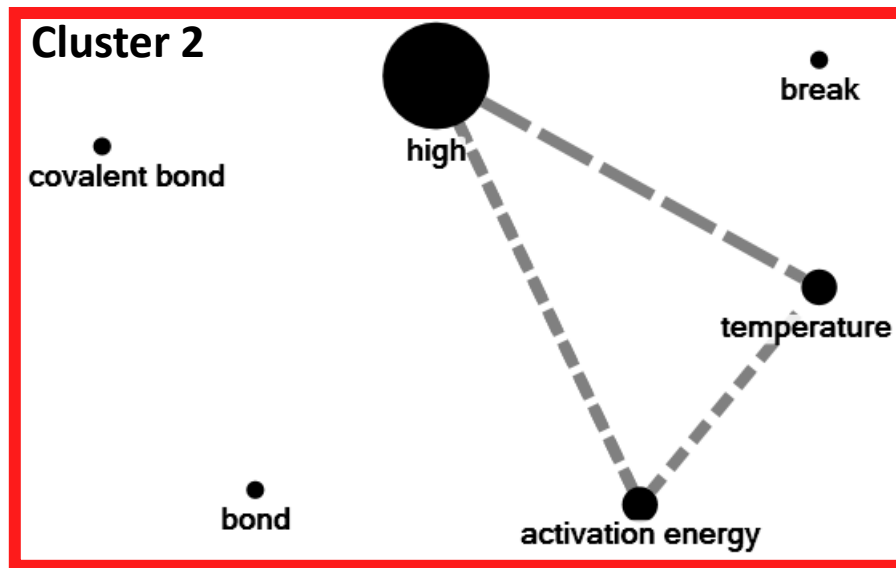
Feedback Report

Cluster 1 Miscellaneous 37.7%	Cluster 2 High temperatures/ Activation Energy 20.9%	Cluster 3 Energy to Break Bond 28.9%	Cluster 4 High Temperature to Break Bonds 12.5%
0.24 temperature 0.13 activation energy 0.02 bond 0.01 break 0.01 covalent bond 0.00 high	0.99 high 0.49 temperature 0.34 activation energy 0.08 bond 0.04 covalent bond 0.01 break	0.88 break 0.78 bond 0.33 covalent bond 0.29 high activation energy 0.05 0.01 temperature	1.00 temperature 0.95 break 0.80 bond 0.61 high 0.21 covalent bond 0.05 activation energy
Example Responses			
This reaction occurs very slowly at room temperature because the reaction is only -3.7 kcal/mol which is a low reaction.	The activation energy is higher at room temperature so it takes longer for the reaction to proceed	because it takes alot of energy to break these bonds.	The reaction occurs slowly at room temperature because the kinetic energy of the atoms is very low. As you increase the temperature the kinetic energy rises which allows for the atoms to move more quickly and then break apart from each other.

A Comparison of student responses

PRE/POST Instruction

		POST			
		Misc.	High Temp/ Activation energy	Bond Breaking	High Temp/ Bond Breaking
PRE	Misc.	48.6	21.4	20.0	10.0
	High Temp/ Activation energy	42.5	35.0	7.5	15.0
	Bond Breaking	39.5	19.8	28.4	12.3
	High Temp/ Bond Breaking	45.2	22.6	25.8	6.5



Instructors response to CR questions and feedback reports

- Created clicker questions and led discussions based on results from feedback report
- Reported that written assessments were particularly important for gaining insight as to *why* students have struggled continuously with certain concepts
- Proposed future in-class activities to improve student writing skills

Improving the use of automated analysis for JiTT

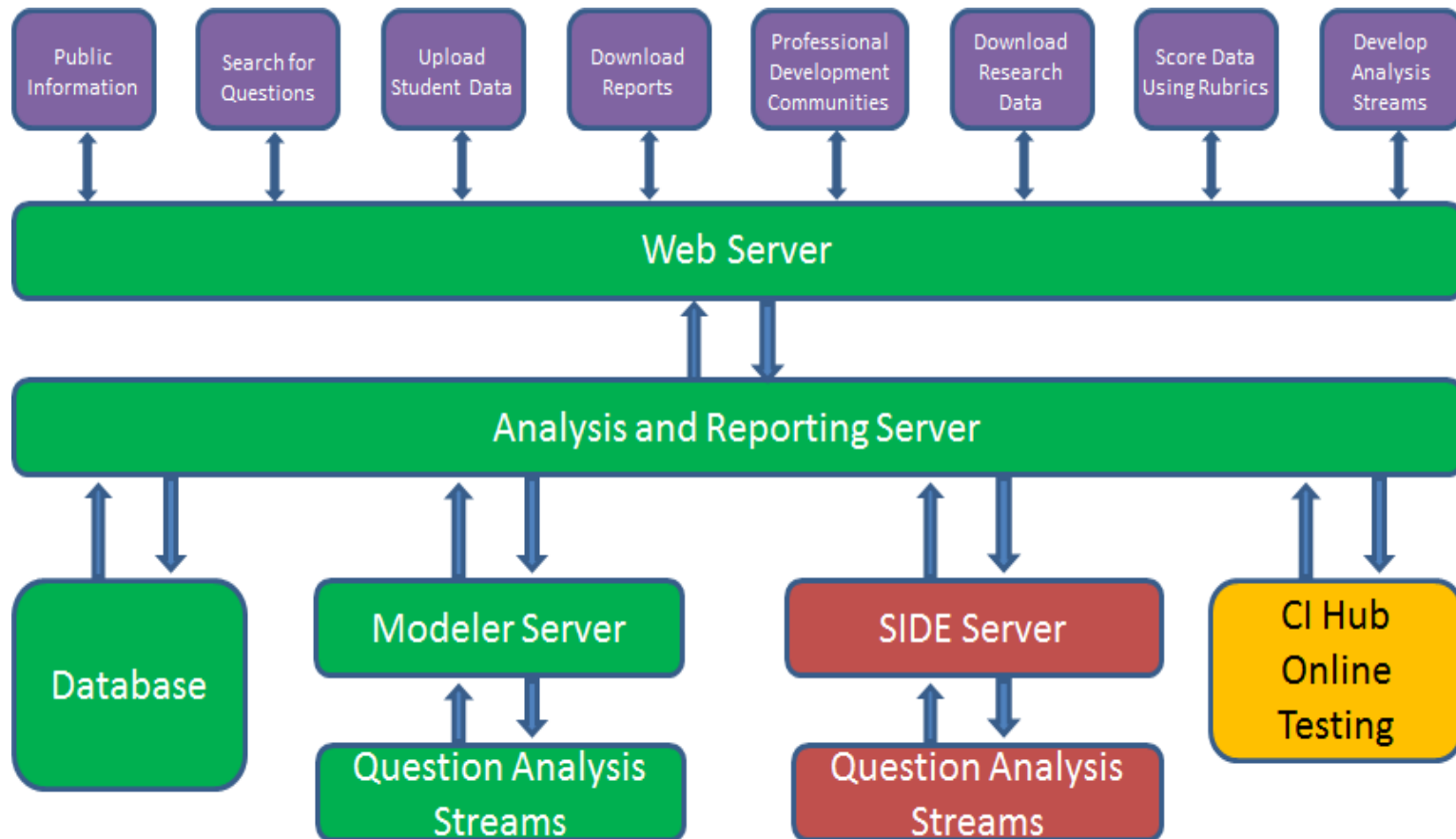
- Encourage student participation by giving credit for homework assignments
- Allow more time between each assignment and the next class for preparing instructional activities
- Professional development for faculty to help them address concepts that students find challenging

Future Directions

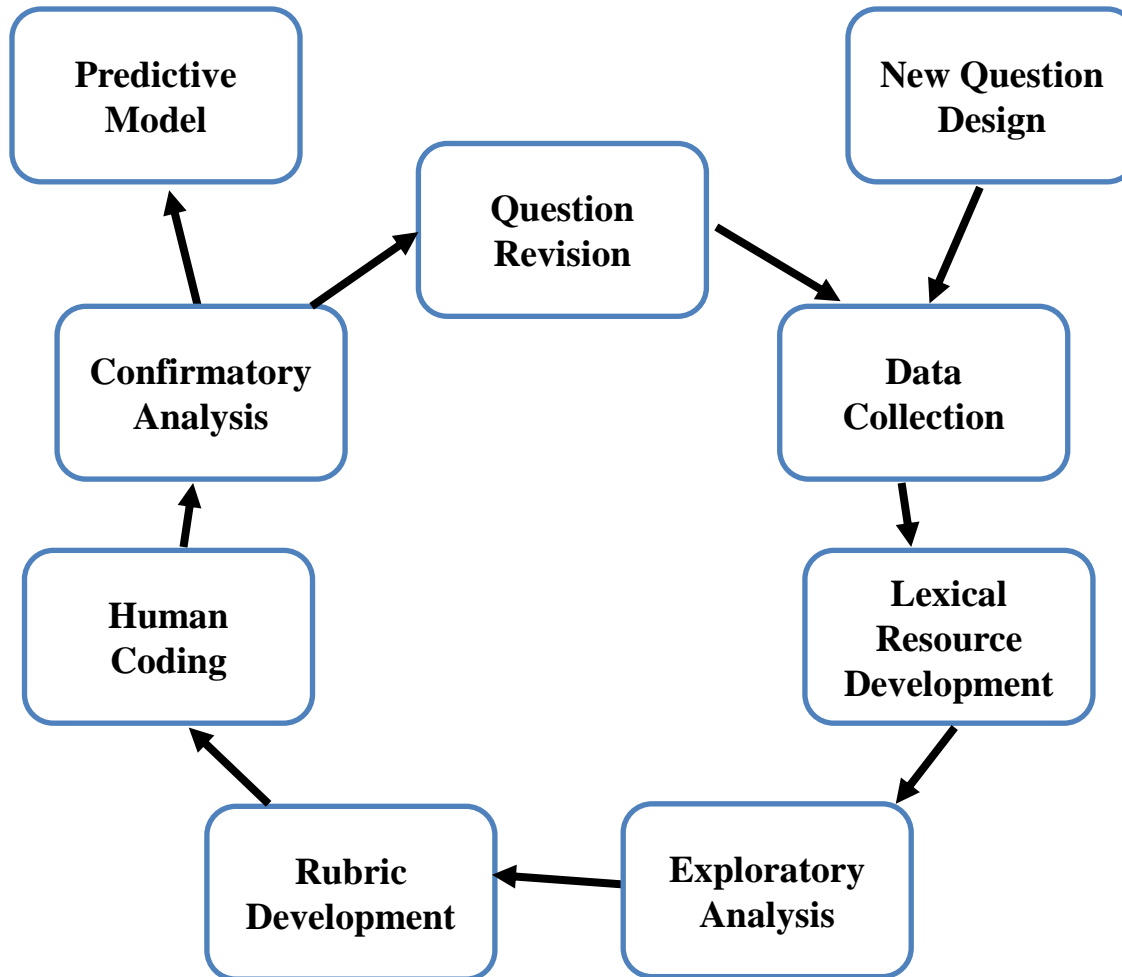
- Communities of Practice
 - Local: groups of faculty within a department/teaching the same course
 - Virtual: faculty across institutions
 - Use the same assessment & share instructional materials

Future Directions

- Web Portal
 - support rapid assessment and feedback



Question Development Cycle



Question Development Cycle

