# "Collaborative Team Projects to Enhance The Quantitative Literacy of Community College Students Majoring In Business"

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The National Numeracy Network
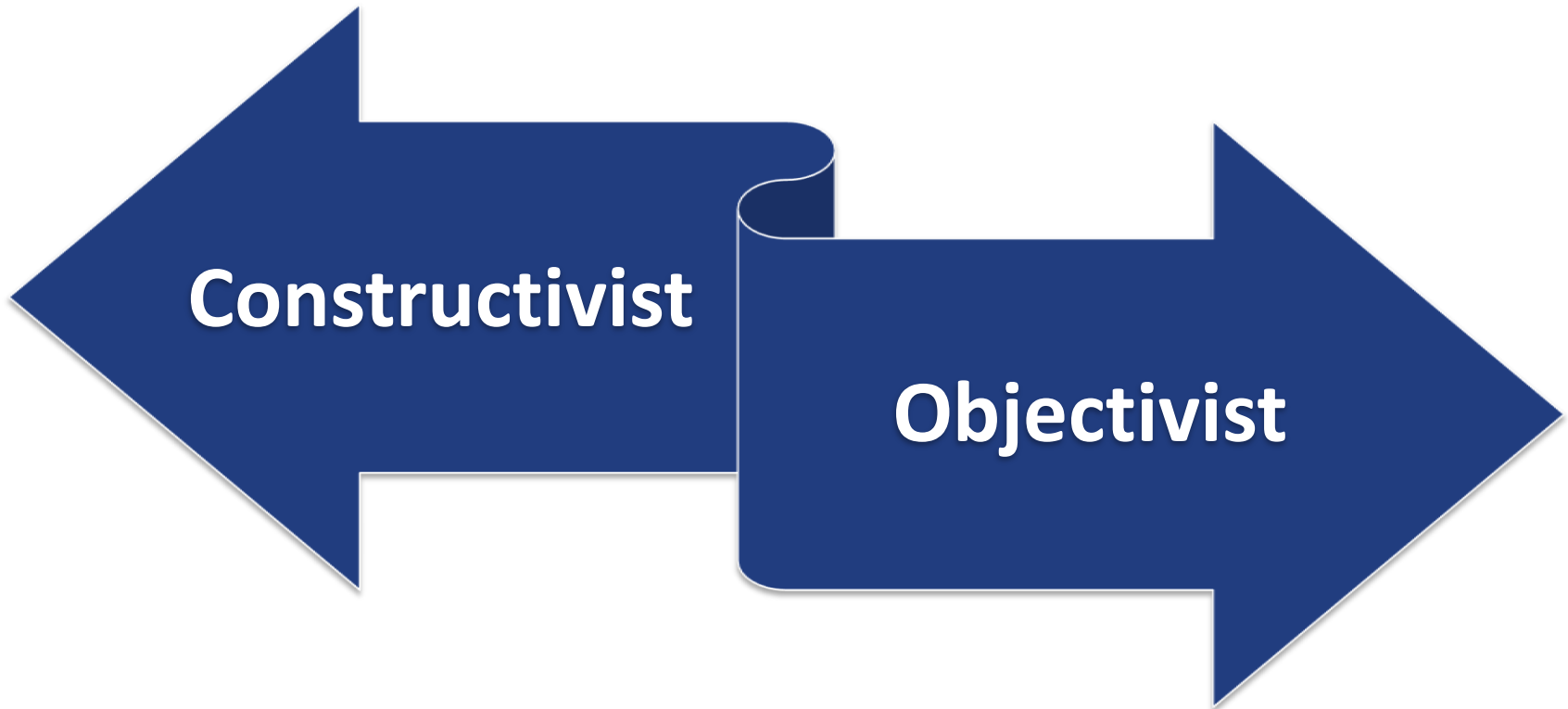**October 12, 2012**

The Research Question:
Does the Collaborative Classroom Foster QL?

Student-Centered
(Guide on the Side)

Instructor-Centered
(Sage of the Stage)
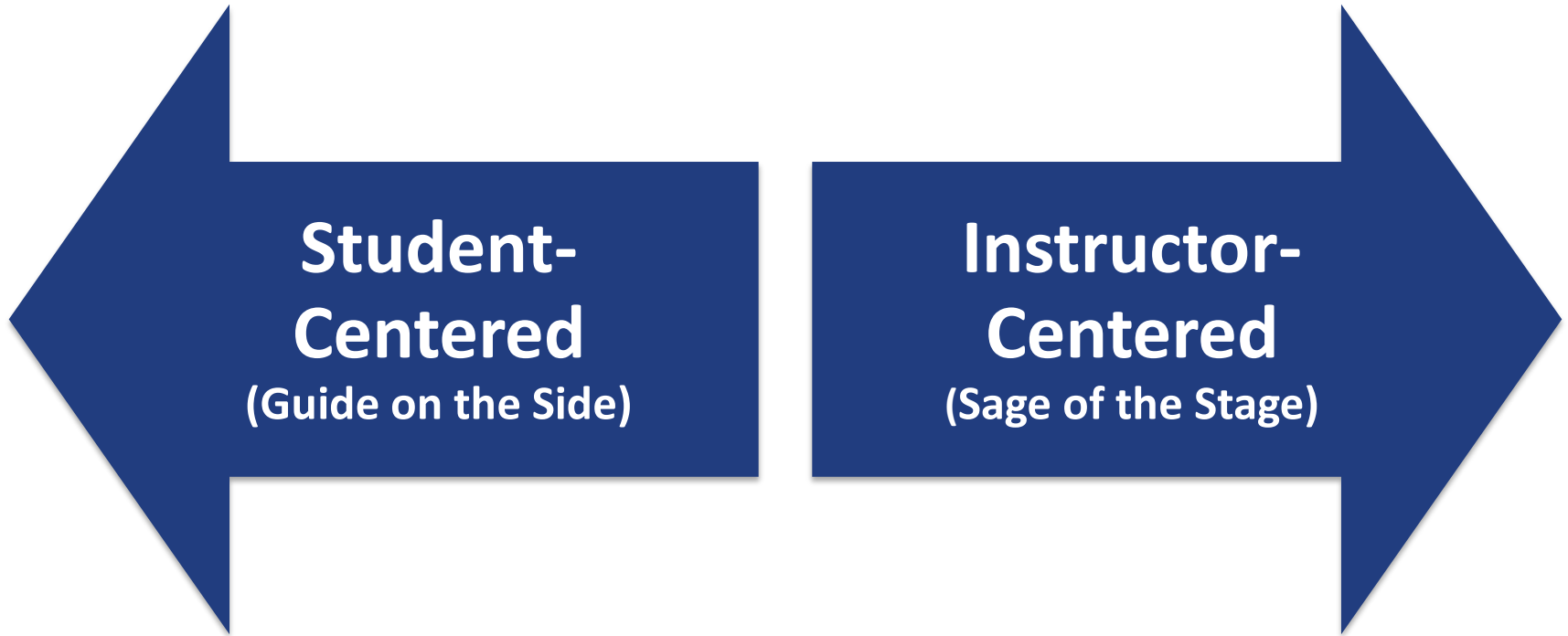
Two "Divergent" Approaches to Teaching

Classroom Activities Based On These Theories Are On A Continuum[1]

Constructivist

Objectivist

[1]Duffy, T. M. & Jonassen, D. H. (1992). Constructivism: New implications for instructional technology. In T. M. Duffy & D. H. Jonassen (Eds.). *Constuctivism and the technology of instruction: A conversation*. Hillsdale, NJ: Erlbaum.

The Research Design

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4 Classes Were Studied
Class 1: Team Projects

Principles of Statistics class taught by this researcher

All students completed a math prerequisite

Students assigned to 1 of 8 teams for 11 projects

20-to-30 minutes of most classes devoted to team projects

Students mentored each other

Students presented solutions to the class

4 Classes Were Studied
Class 2: Assigned Homework

Principles of Statistics class taught by this researcher

Students assigned 11 homework assignments

Homework was graded

Students worked alone and competed against each other

Students listened to the instructor's lectures

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4 Classes Were Studied
Class 3: Control Class A

Statistics class taught by a popular senior professor

Instructional style skews Objectivist: Lectures and homework

Class included to determine if a different instructor would achieve different results

4 Classes Were Studied
Class 4: Control Class B

Introduction to Business Class taught by this researcher

Introductory survey course with little quantitative content

Students typically in their first or second semester

Students taking remedial math or math prerequisites

1) Do QL scores of more junior students improve during the semester?
2) Are their QL scores below more senior students?

Demographics Similar Across All Classes

Demographics	Team Projects	Home-work	Control Statistics	Intro. To Business
Number of Students	17	15	17	23
Number of Men	8	7	9	12
Number of Women	9	8	8	11
Average Age	21.03	23.36	21.28	19.59
Av. Credits Earned	39.80	34.96	39.46	9.57
Taking Remedial Math	0	0	0	10
Completed Math Requirement	All	All	All	None
English is 1st Language	8	3	6	6

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Research Design

Research Instrument tested & modified semester before study

CITI certified "Co-PI" administered surveys as per IRB

Instrument administered twice during the semester

Week #2 to get base QL levels (Wave 1)

Second to last week to determine if QL improved (Wave 2)

Only students who completed both surveys included

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Research Instrument Covered 2 Dimensions

Cognitive	Affective
• **The ability to reason and solve everyday quantitative problems**	• **Comfort, confidence, "at homeness"**

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Cognitive Dimensions

Questions developed by reviewing QR textbooks, QL questions posted on the Internet, and the UK's *Skills for Life Program*, an initiative for improving adult literacy

20 multiple-choice questions

Students provided with hand-held calculators

Cognitive Dimensions *(Continued)*

Numbers sense: Facility with decimals, fractions and percentages

Accurate estimation and calculation

Interpretation of tables, charts, and graphs

Ability to make sound judgments based on calculations

Affective Dimension:
Modified Fennema-Sherman Attitude Scales*

Woodrow Wilson National Fellowship Foundation granted permission to use these scales to measure Attitudinal aspects of QL

Questions focused on "at homeness" or confidence learning and applying math

12 Likert questions covering 6 areas (one set of questions stated in the affirmative, one in the negative)

Questions stated in the negative were dropped because initial tests prior to fielding the study showed answers not internally consistent

*Scale modified by Ellen Lawsky, Geri Marchioni, and Linda Padwa

Findings

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#1: Pre-Post t-Tests show Cognitive Skills Increased Only in the Team Projects Class

Paired t-tests	Team Projects	Home-work	Control Statistics	Intro. To Business
n	17	15	17	23
QL Cognitive Score Wave 1				
Mean	0.668	0.567	0.697	0.457
Standard Deviation	0.1936	0.2160	0.1900	0.2063
QL Cognitive Score Wave 2				
Mean	0.791	0.577	0.671	0.452
Standard Deviation	0.1253	0.2314	0.1829	0.2534
t-Value	3.466	0.160	-0.759	-0.142
p-Value	0.003	0.875	0.459	0.888

Significant Increase

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#2: Cognitive Scores Not All Equal at Wave 1

Treatments	n	M	SD
Team Projects	17	0.668	0.1936
Homework	15	0.567	0.2160
Control Statistics	17	0.697	0.1900
Intro. To Business	23	0.457	0.2063

Source of Variation	SS	df	MS	F	p
Between Groups	0.714	3	0.238	5.851	0.001
Within Groups	2.767	68	0.041		
Total	3.481	71			

Post Hoc Analysis: p-Values for Pairwise t-Tests

Wave 1		Intro. To Business	Home-work	Team Projects	Control Statistics
	Mean	0.457	0.567	0.668	0.697
Intro. To Business	0.457				
Team Projects	0.668	0.0017*			
Homework	0.567	0.1045	0.1622		
Control Statistics	0.697	0.0004*	0.0724	0.6721	

*Significant Difference

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#3: Cognitive Scores Not All Equal at Wave 2

Treatments	n	M	SD
Team Projects	17	0.791	0.1253
Homework	15	0.577	0.2314
Control Statistics	17	0.671	0.1839
Intro. To Business	23	0.452	0.2534

Source of Variation	SS	df	MS	F	p
Between Groups	1.210	3	0.403	9.304	>0.001
Within Groups	2.948	68	0.043		
Total	4.158	71			

Team Project class higher than Homework class

Post Hoc Analysis: p-Values for Pairwise t-Tests

Wave 2		Intro. To Business	Home-work	Team Projects	Control Statistics
	Mean	0.452	0.577	0.791	0.671
Intro. To Business	0.452				
Team Projects	0.791	>0.0001*	0.0049	0.0959	
Homework	0.577	0.0761			
Control Statistics	0.671	0.0016*	0.2072		

*Significant Difference

#4: No Change in Affective Scores

Chi-Square Goodness-of-Fit Tests

	Team Projects	Home-work	Statistics Control	Intro. To Business
χ^2	2.719	5.587	5.714	3.866
p-Value	0.606	0.232	0.222	0.581

Part t-tests	Team Projects	Home-work	Statistics Control	Intro. To Business
n	17	15	17	23
QL Affective Scores Wave 1				
Mean	2.941	1.000	5.471	2.652
Standard Deviation	6.638	5.318	5.864	4.725
QL Affective Scores Wave 2				
Mean	2.941	3.667	6.235	2.652
Standard Deviation	6.905	4.685	5.333	4.356
t-Value	0.000	-1.449	-0.460	0.225
p-Value	1.000	0.169	0.652	0.824

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#5: No Difference in the Affective Scores

Wave 1

Treatment	n	M	SD
Team Projects	17	2.941	6.638
Homework	15	1.000	5.318
Control Statistics	17	5.471	5.864
Intro. To Business	23	2.652	4.725

ANOVA Table: Wave 1 - Affective Dimensions

Source	SS	df	MS	F	p-Value
Between Groups	168.48	3	3.00	1.76	0.1628
Within Groups	2,142.39	68	18.00		
Total	2,308.88	71			

Wave 2

Treatment	n	M	SD
Team Projects	17	2.941	6.905
Homework	15	3.667	4.685
Control Statistics	17	6.235	5.333
Intro. To Business	23	2.652	4.356

ANOVA Table: Wave - Affective Dimensions

Source	SS	df	MS	F	p-Value
Between Groups	158.47	3	52.82	1.85	0.1466
Within Groups	1,942.81	68	28.57		
Total	2,101.28	71			

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Conclusion #1

Data suggest that constructivist learning activities enhance the cognitive aspects of QL

Conclusion #2

Data does not suggest that the affective aspects of QL improved as a result of constructivist or behaviorist learning activities