The Impact of Agricultural Science Education on Performance in a Biology Course

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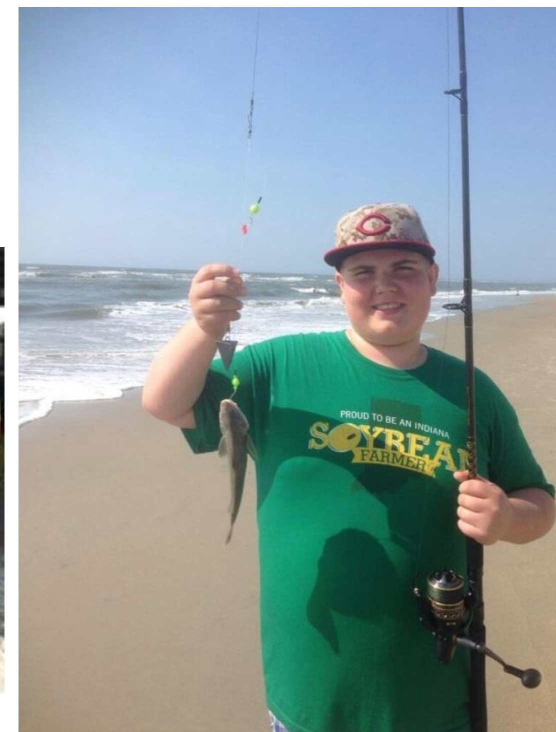

This presentation is based on research done to effect social change in meeting the doctoral requirements of Walden University

Teaching Vs. Pouring Espresso

Pouring espresso (Teaching) is an art, one that requires the barista (teacher) to care about the quality of the beverage (education). If the barista (teacher) only goes through the motions, if he or she does not care and produces an inferior espresso (student) that is too weak or too bitter (not ready to compete), then Starbucks (teaching) has lost the essence of what we set out to do 40 years ago (in 1635): inspire the human spirit. I realize this is a lofty mission for a cup of coffee (education), but this is what merchants (teachers) do. We take the ordinary – a shoe (boy), a knife (girl) – and give it (them) new life, believing that what we create has the potential to touch others' lives because it (their lives) touched ours.

Adapted from Schultz, H. (2011). In Onward: How Starbucks fought For its life without losingits soul (p. 4). Thousand Oaks, CA: Sage.

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Walden University Research

A Mixed Methods Explanatory Study of the Impact of Agricultural Science on Student Achievement and Performance in Science in a Midwestern High School

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Why

This research study investigated low student achievement in science and the social change impact of real-world application through the study of agricultural science.

The Hand In The Back of the Room

Education exists in the larger context of society.

When society changes – so too must education if it is to remain viable.

Purpose

The purpose of this mixed methods explanatory study was to investigate the relationship between the completion of Fundamentals of Agriculture Science and Business, the state approved introductory agriculture course, and student achievement in Biology I as measured by the end of course assessment and the course grade.

Problem

The problem addressed in this study was the lack of student achievement in science as measured by high school level exams.

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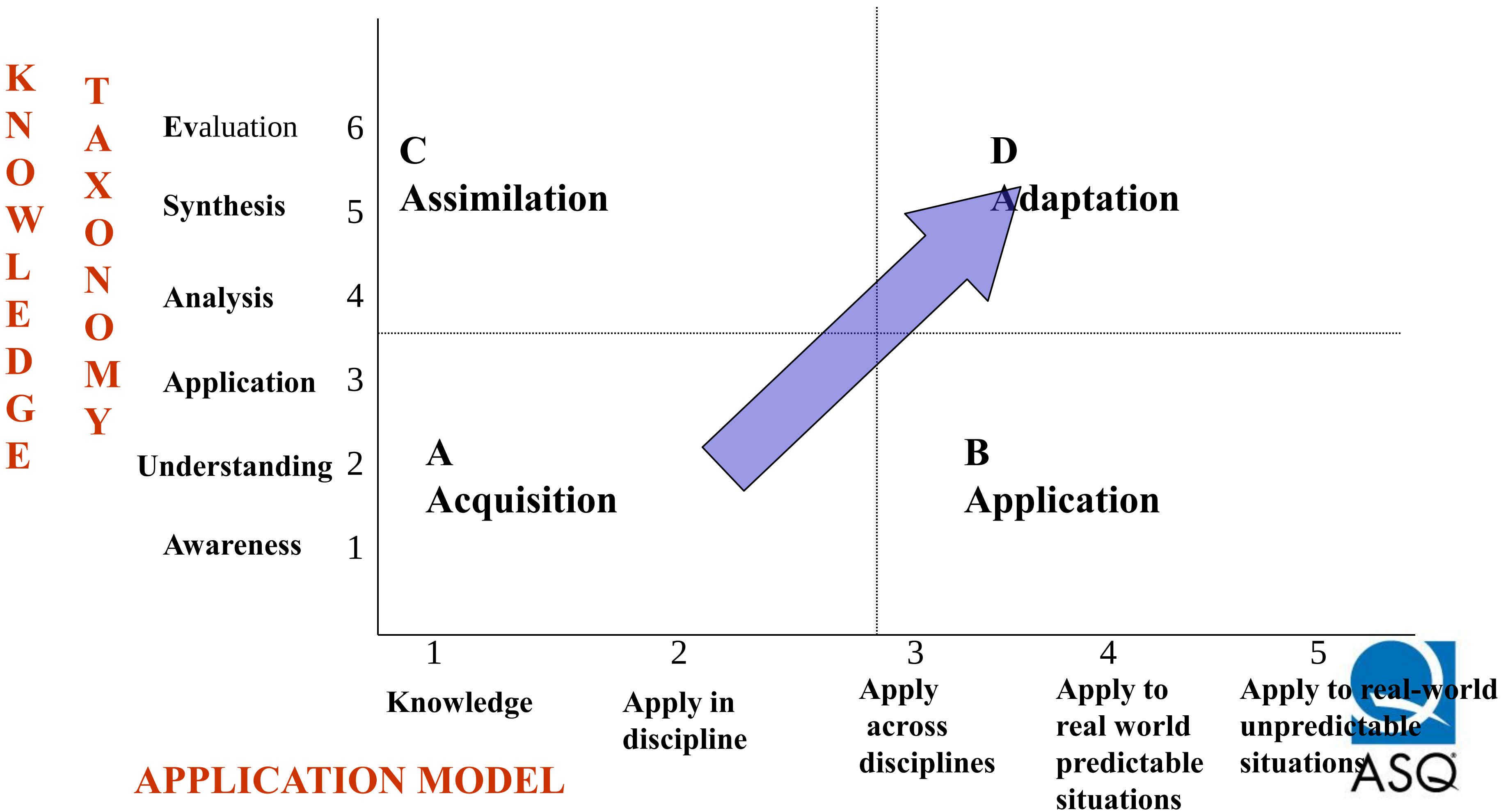
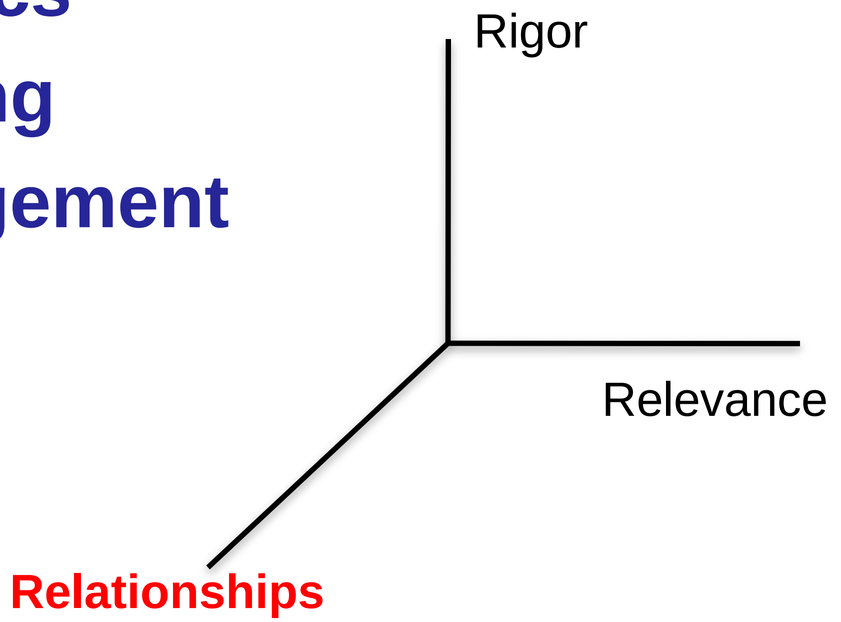
The Rigor/Relevance Framework



International Center for Leadership in Education

Success Beyond the Test

- **Core Academics**
- **Stretch learning**
- **Learner Engagement**
- **Personal Skill Development**



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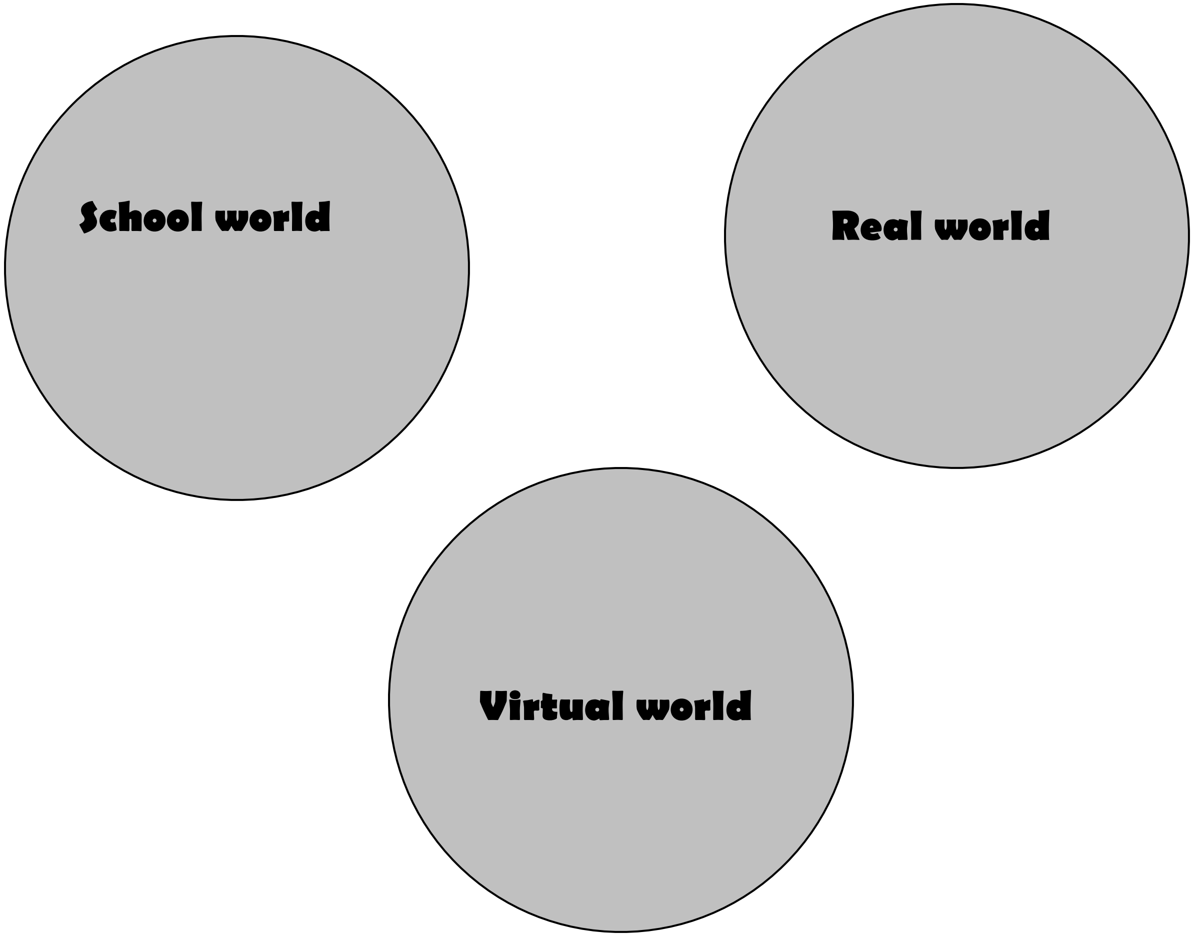
Relationships

It is virtually impossible to make things relevant for, or expect personal excellence from, a student you don't know.

~Carol Ann Tomlinson

Three Worlds of the Student



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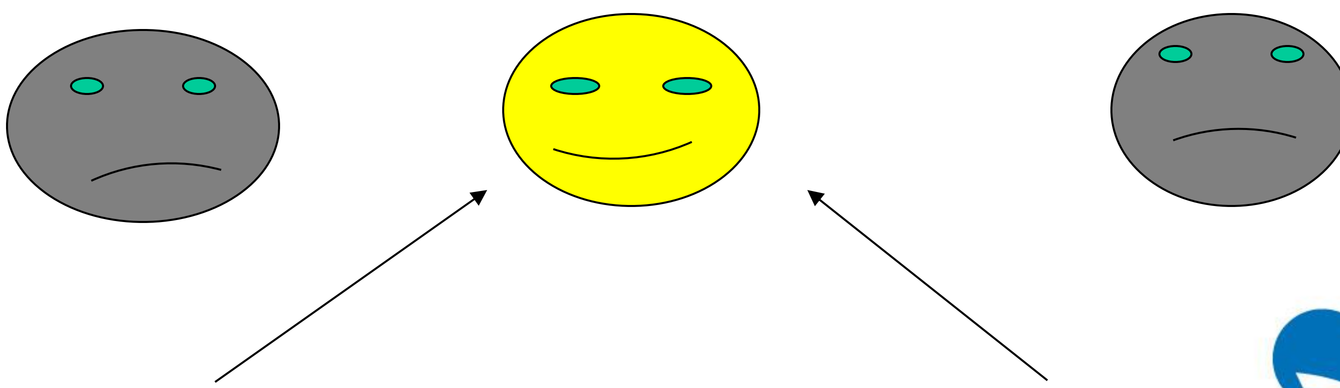
What Zone Am I In?

Too Easy
- I get it right away…
- I already know how…
- This is a cinch…
- I'm sure to make an A..,
- I'm coasting…
- I feel relaxed,,,
- I'm bored…
- No big effort necessary.

On Target
- I know some things…
- I have to think…
- I have to work…
- I have to persist…
- I hit some walls…
- I'm on my toes…
- I have to regroup…
- I feel challenged…
- Effort leads to success..

Too Hard
- I don't know where to start…
- I can't figure it out…
- I'm spinning my wheels…
- I'm missing key skills…
- I feel frustrated…
- I feel angry…
- This makes no sense…
- Effort doesn't pay off…



THIS is the place to be. THIS is the achievement zone.

Setting & Sample

- The population used in this study were Biology I students (n=486) in an Indiana high school taking the State Biology I End of Course Assessment (ECA).
- The population for the qualitative sequence included all science and agriculture teachers (n=10) in the study school.

Instruments & Data Analysis

- The source for student achievement data was the Indiana Biology I ECA scores Biology I student grades.
- A convenience sample of all science and agriculture teachers (n=10) were interviewed as the data source for the qualitative sequence.

Review of Literature

The review of literature was organized into eight sections:

1. Theoretical framework for the study.
2. Science education.
3. Focus on agricultural education.
4. Student achievement in science is framed as a national problem.

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Review of Literature (Con' t.)

5. Studies conducted on the impact of integrating curriculum.
6. Focus on the framework for science taught in the context of agriculture.
7. Review of the collaborative environment of the learning organization and how it can impact integration of science in all subjects.
8. Summary of the methodologies used for the studies included in the literature review.

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Theoretical Framework

- The theories that provided the framework for this study were:
  - Vygotsky' s (1978) constructivist theory
  - Gardner' s (1993) multiple intelligences.

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Science Education

- Holbrook (2010) posited that with all the science-driven technology that science should be taught in the context of issue-based or context-based learning.
- Chow (2011) recommended the U.S. needed to expand STEM-capable workers by expanding the "incoming pipeline" (p. 137).

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Agricultural Education

Duschl (2008) asserted that science is a social activity that must involve cross-disciplinary work. Science learning is an active process and the integrated use of real contexts can foster the connections necessary to make the link for students between science and everyday life.

Student Achievement in Science

- Brophy, Klein, Portsmor, and Rogers (2008) posited that the relevant context of STEM education contributed to students' problem solving, critical thinking, and analytical thinking skills.
- Tolbert (2011) pointed to the need for identifying best practices for contextualized instruction.

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Impact of Integrating Curriculum

- Studies show students involved in active, relevant learning in real life contexts acquire knowledge and become proficient in problem-solving (Robertson, 2008).
- Wong and Hodson (2009b, 2010) advocated the development of contextualized real world case studies and authentic scientific descriptions to serve as teaching resources.

Science Taught in the Context of Agriculture

- Hoban and Severson (2011) asserted higher quality learning occurs when connections between classroom and a real life context making the connection to the real world.
- According to Emo (2007) students learning science in the context of agriculture receive the tools and thought processes to effectively learn higher level science concepts.

Learning Organization

- Scott and Dixon's (2009) evaluative research showed that when teachers had the opportunity to reflect with each other on pedagogical knowledge, share resources, collaboratively develop ideas, and observe alternative teaching strategies the impact was significant.

Methodology

A mixed methods explanatory design was used to quantitatively investigate the relationship between the successful completion of the high school course Fundamentals of Agriculture Science and Business and student achievement in science and qualitatively explore teacher perceptions regarding the integration of the science and agriculture curricula.

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Quantitative Research Question #1

Is there a significant relationship between the successful completion of the high school course Fundamentals of Agriculture Science and Business (independent variable) and student achievement as measured by the Indiana Biology I End of Course Assessment percentage score (dependent variable)?

Quantitative Research Question #2

Is there a significant relationship between the successful completion of the high school course Fundamentals of Agriculture Science and Business (independent variable) and student performance in Biology I as measured by course grade percentage scores (dependent variable)?

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Quantitative Research Question #3

Is there a significant difference in passing Indiana's Biology I End of Course Assessment (dependent variable) between students who have successfully completed the high school course Fundamentals of Agriculture Science and Business and students who have not successfully completed the high school course Fundamentals of Agriculture Science and Business (independent variable)?

Quantitative Sequence

Student data for the first and second quantitative research questions investigating the correlation between the successful completion of the high school course Fundamentals of Agriculture Science and Business (independent variable) and student achievement as measured by the Indiana Biology I ECA percentage score (dependent variable) and student performance in Biology I as measured by course grade percentage scores (dependent variable) were analyzed using the point-biserial correlation.

Quantitative Sequence (continued)

Student data for the third research question in the quantitative series investigating if there is a significant difference in passing Indiana's Biology I ECA (dependent variable) between students who have successfully completed the high school course Fundamentals of Agriculture Science and Business (independent variable) was analyzed using a Chi Square two-sample test.

Qualitative Research Question

What are the perceptions and experiences of teachers of science and agriculture regarding the integration of science and agricultural education curricula?

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Teacher Interview Questions

1. Tell me about your experiences teaching a science lesson in the context of agriculture.
2. How was planning for teaching a science lesson in the context of agriculture different from other lessons?
3. What teaching strategies have you used when teaching science lessons in the context of agriculture?
4. Describe the impact of science taught in the context of agriculture on student learning of science concepts.
5. How has science taught in the context of agriculture impacted your students' ability to solve problems and think critically?
6. What has been your experience related to student motivation when learning science in the context of agriculture?
7. Are there any additional points you would like to discuss or comments you would like to add?

Qualitative Sequence

This study used typological and inductive analysis to develop the coding for the qualitative sequence.

Quantitative Findings – RQ 1

Table 1 – Point-Biserial Correlations For End of Course Assessment

		Fund of Ag Science	ECA Score
Fund of Ag Science	Point-Biserial Correlation	1	.364**
	Sig. (2-tailed)		.000
	N	486	486
ECA Score	Point Biserial Correlation	.364**	1
	Sig. (2-tailed)	.000	
	N	486	486

Using the sample of 486 students there was a statistically significant correlation of .364 for students taking Fundamentals of Agriculture Science and Business and the same students' achievement on the Indiana Biology I End of Course Assessment (see Table 1).

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Quantitative Findings – RQ 2

Table 2 – Point-Biserial Correlations For Biology I Grade Percentage

		Fund of Ag Science	Biology I Grade
Fund of Ag Science	Point-Biserial Correlation	1	.351**
	Sig. (2-tailed)		.000
	N	486	486
Biology I Grade	Point-Biserial Correlation	.351**	1
	Sig. (2-tailed)	.000	
	N	486	486

A .351 point-biserial correlation was found and the correlation was significant at the 0.01 level (2-tailed) as seen in Table 2.

Quantitative Findings – RQ 3

Table 3 – Biology I End of Course Assessment Chi-Squared Observed/Expected Data

	Observed N	Expected N	Residual
0 Not Passing ECA	208	243.0	-35.0
1 Passing ECA	278	243.0	35.0
Total	486		

Agriculture Science and Business, as seen in Table 5. The percentage of participants that passed the Indiana Biology I End of Course Assessment was higher for those who had successfully completed the Fundamentals of Agriculture Science and Business course, $c^2(1, N=486) = 10.08, p=.001$.

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Quantitative Findings – RQ 3

Table 4 – Biology I End of Course Assessment Chi-Squared Test Statistics

	Biology I ECA
Chi-Square	10.082[a]
df	1
P - value	.001

0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 243.0.

Agriculture Science and Business, as seen in Table 4. The percentage of participants that passed the Indiana Biology I End of Course Assessment was higher for those who had successfully completed the Fundamentals of Agriculture Science and Business course, $c^2(1, N=486) = 10.08, p=.001$.

Qualitative Findings

- The qualitative data were collected to answer the Qualitative Research Question: What are the perceptions and experiences of teachers of science and agriculture regarding the integration of science and agricultural education curricula?

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Qualitative Findings

Two themes emerged during data analysis:

- Student Impact
  - Student Motivation
  - Interested & Inquisitive
  - Real World Activities
  - Relevance of Agriculture Context
  - Agriculture is Made up of Science
  - Application to Other Courses

- Teacher Experience
  - Positive Experience
  - More Training Needed

Interpretation of Results

The results for this mixed methods explanatory study were as follows:

- There was a statistically significant correlation for students taking Fundamentals of Agriculture Science and Business and student achievement on the Indiana Biology I End of Course Assessment;
- Students who took Fundamentals of Agriculture Science and Business were significantly more likely to score higher on the Biology I course grade percentage;
- Teachers reported a positive experience and perceived positive student impact from teaching science concepts in the context of agriculture

Interpretation of Findings

Science should be taught in a relevant context, which enables the student to think critically, explore phenomena, and solve meaningful everyday problems.

Interpretation of Findings

Inquiry-based science methods taught in the context of agriculture support many national and state core standards in science.

Interpretation of Findings

Facilitating learning should use contexts where the student plays an active role.

Student-centered practices improve student engagement and motivation.

Interpretation of Findings

The understanding of science concepts expressed by the teacher participants was that higher quality learning occurs when connections between classroom and a real life context are made.

Interpretation of Findings

There must be effective in-service to increase agriculture science teachers' knowledge of science and the methods to teach science content.

Implications for Social Change

Social change is possible through improved science education for all students, using agriculture science courses to facilitate learning of complex science concepts, designing teacher collaboration and professional development for teaching science in a relevant context, and resultant improved student achievement/performance in science.

Recommendations for Action

- (a) School districts should make use of their agriculture science courses to supplement the learning of complex science concepts;
- (b) Teachers of agriculture science and science should collaborate to share best practices and learned knowledge from teaching science in a relevant context;
- (c) Professional development should be formulated and carried out on teaching science in a relevant context.

Learning Criteria

- **Core Academics –** Achievement in the core subjects of English language arts, math, science, social studies and others identified by the school or district
- **Stretch Learning –** Demonstration of rigorous and relevant learning beyond the minimum requirements

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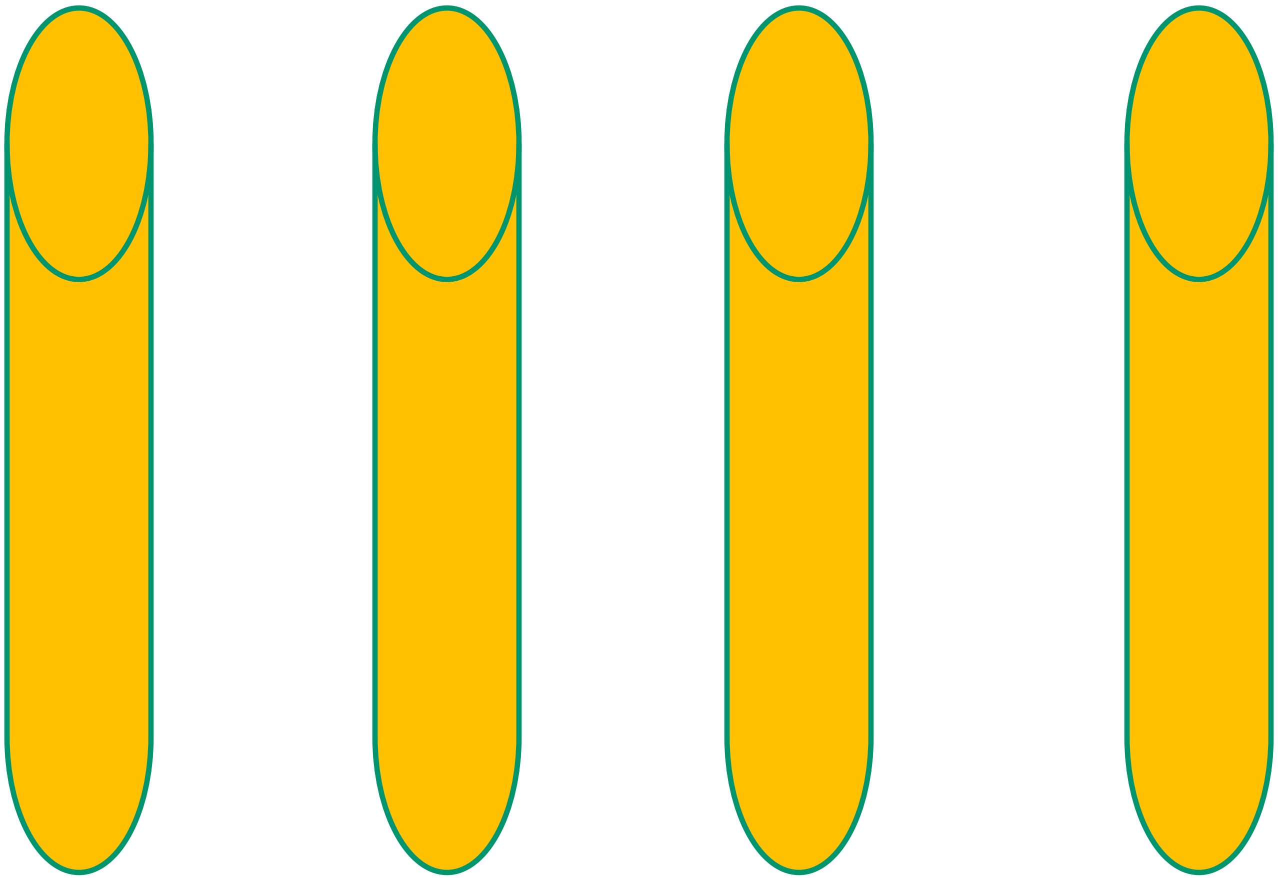
Learning Criteria

- **Learner Engagement –** The extent to which students are motivated and committed to learning; have a sense of belonging and accomplishment; and have relationships with adults, peers and parents that support learning

- **Personal Skill Development –** Measures of personal, social, service, and leadership skills and demonstrations of positive behaviors and attitudes

Learning Criteria



Core

Stretch

Learner Engagement

Personal Skill Development

Learning Criteria

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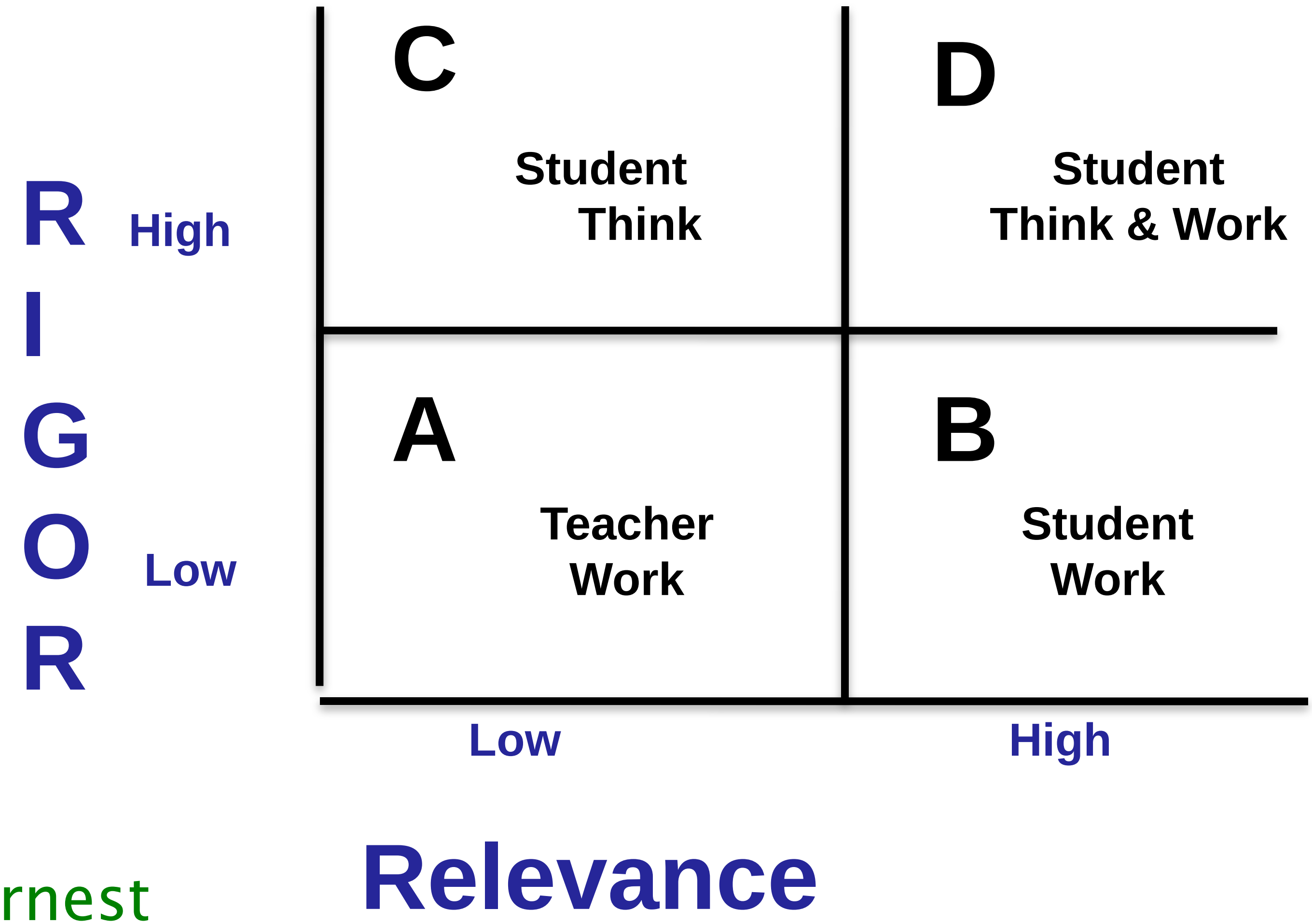
Rigor/Relevance Framework: Teacher/Student Roles



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Creating a Learning Environment for 21st & 1/2 Century Skills

Students working in teams to experience and explore relevant, real-world problems, questions, issues, and challenges; then creating presentations and products to share what they have learned.

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Relevant & Engaging Skills

To learn collaboration **–**

work in teams

To learn critical thinking –

t**ake on complex problems**

To learn oral communication –

present

To learn written communications –

write

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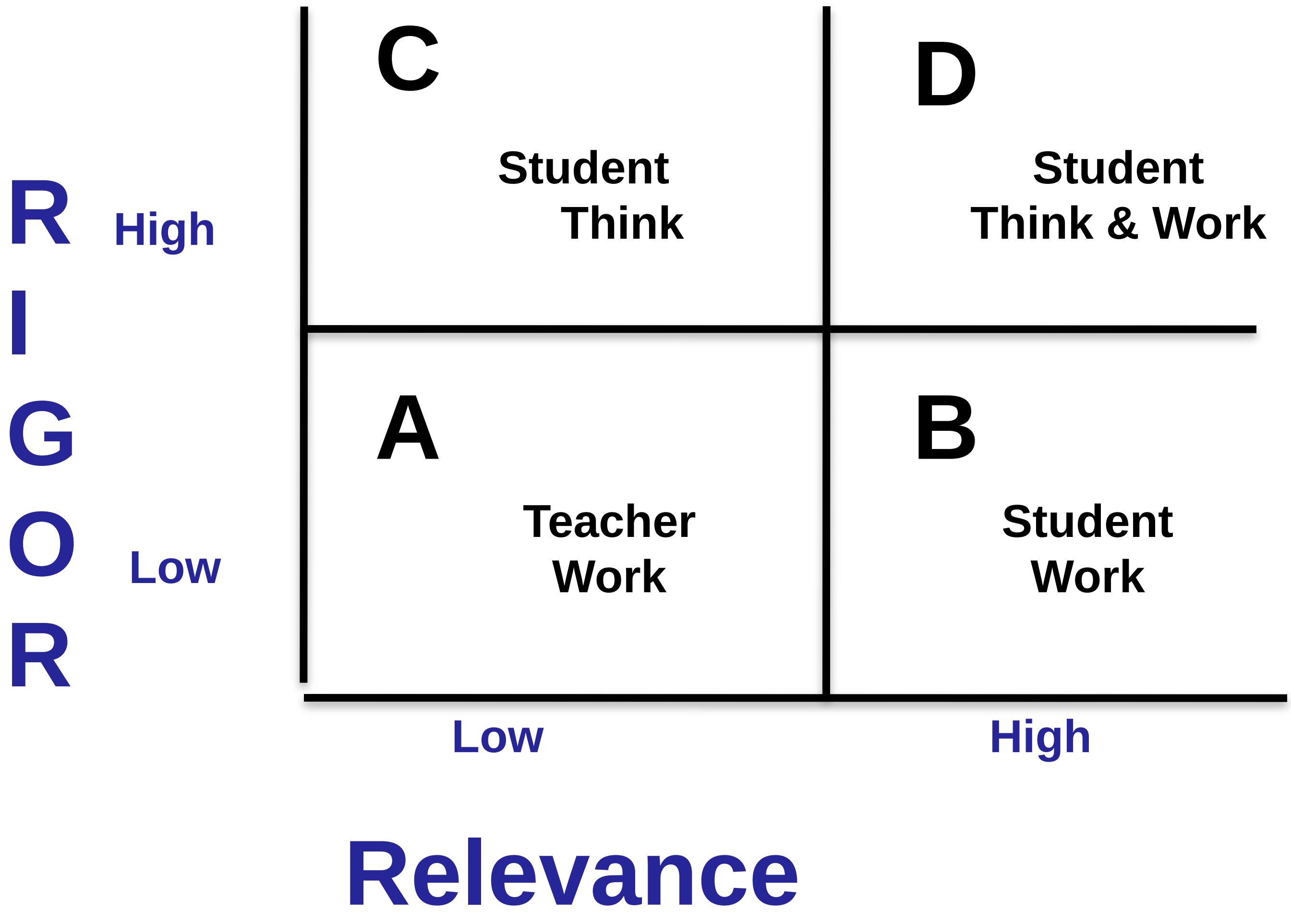
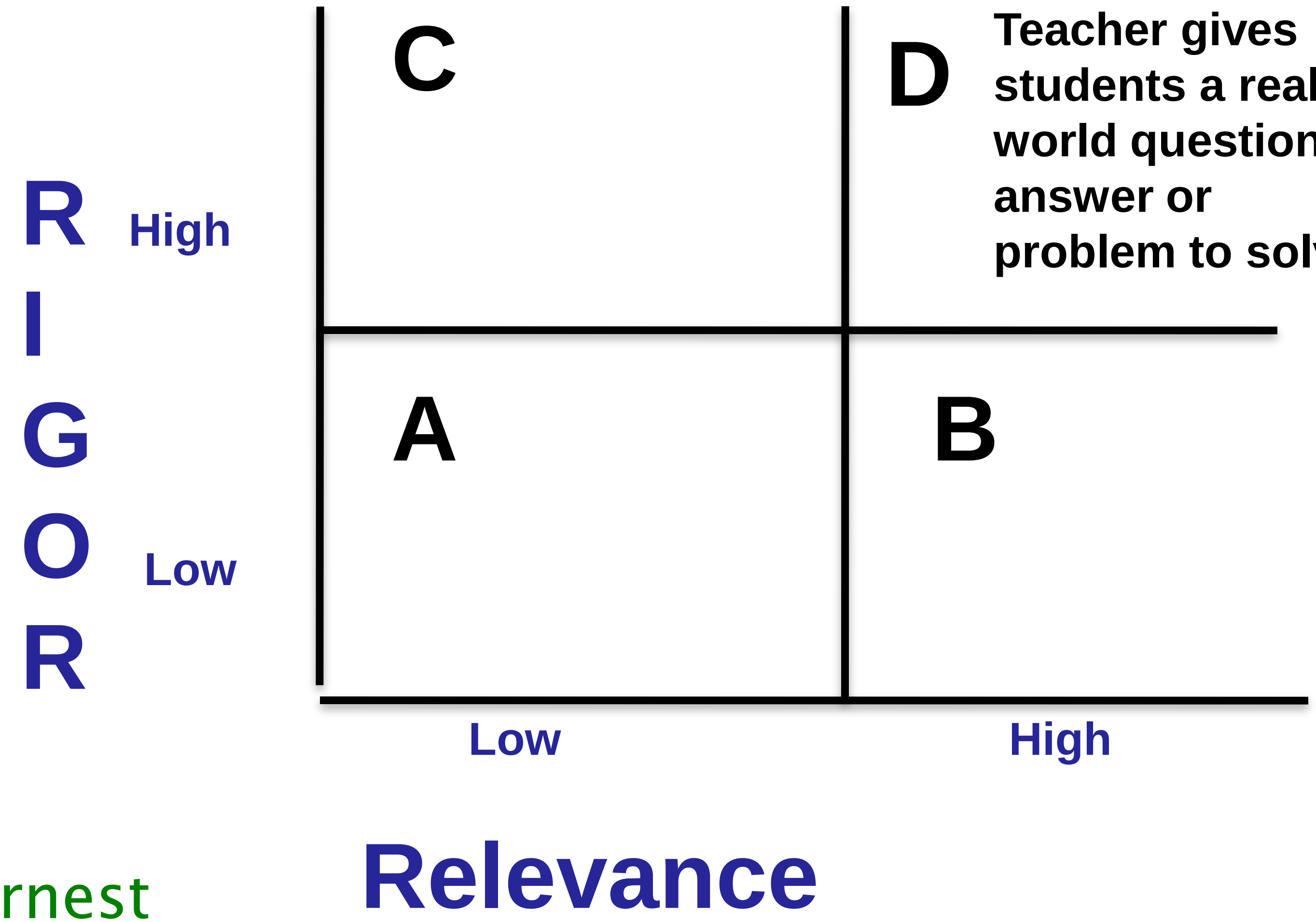
Students Develop Needed Skills in

- Information Searching & Researching
- Critical Analysis
- Summarizing and Synthesizing
- Inquiry, Questioning and Exploratory Investigations
- Design and Problem-solving

Rigor/Relevance Framework Teacher Student Roles



Rigor/Relevance Framework – Step 1



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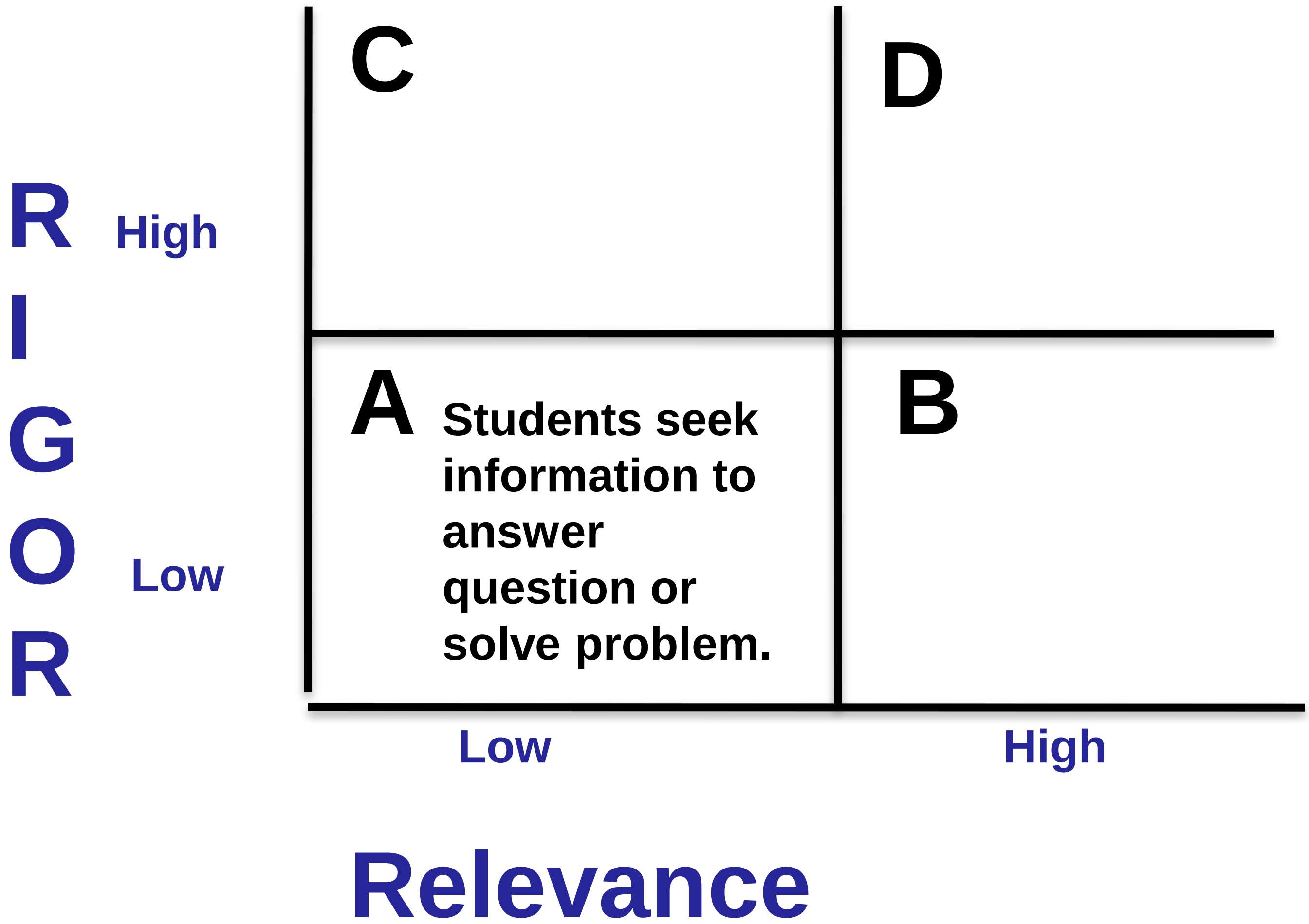
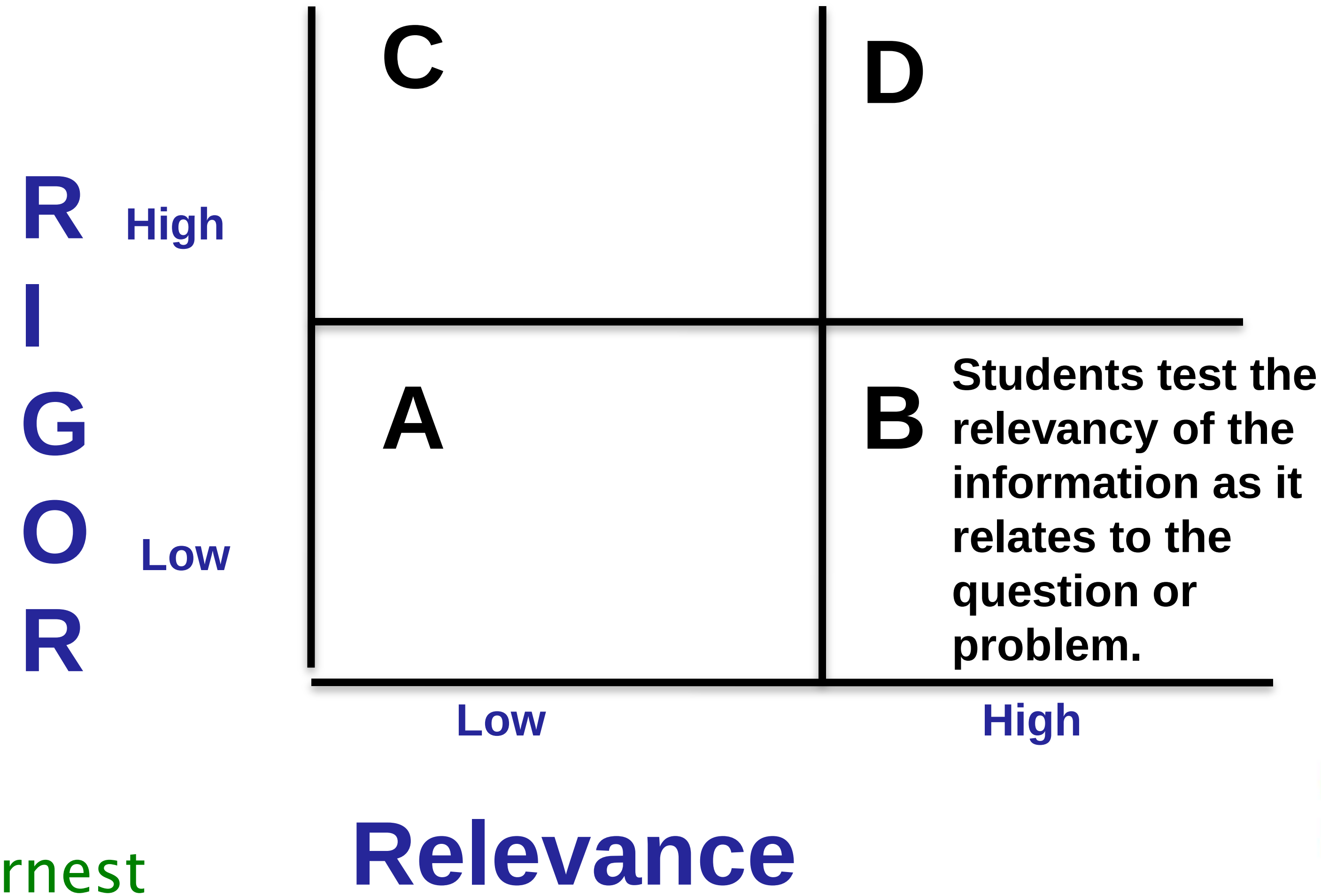
Rigor/Relevance Framework – Step 2



Rigor/Relevance Framework – Step3



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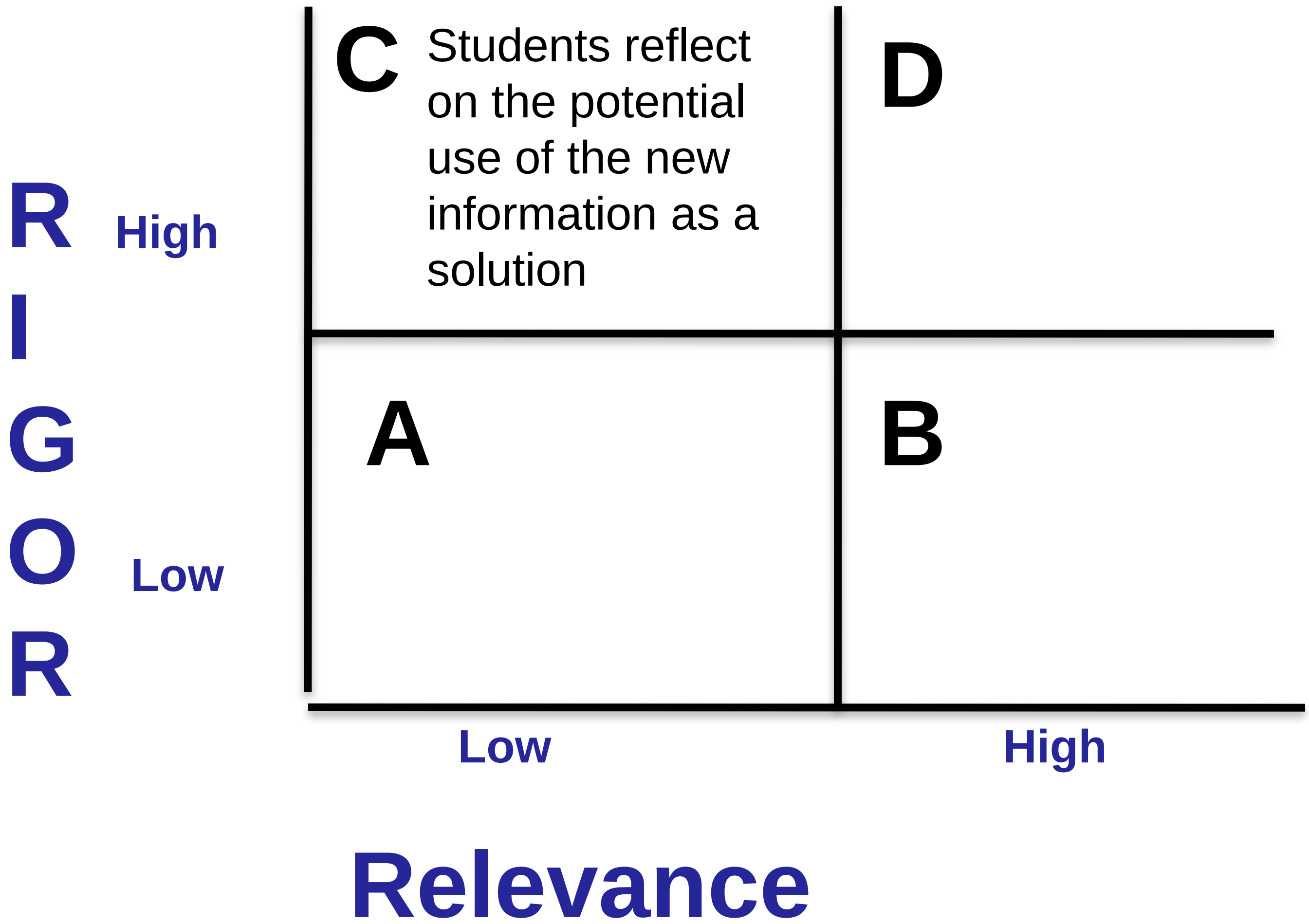
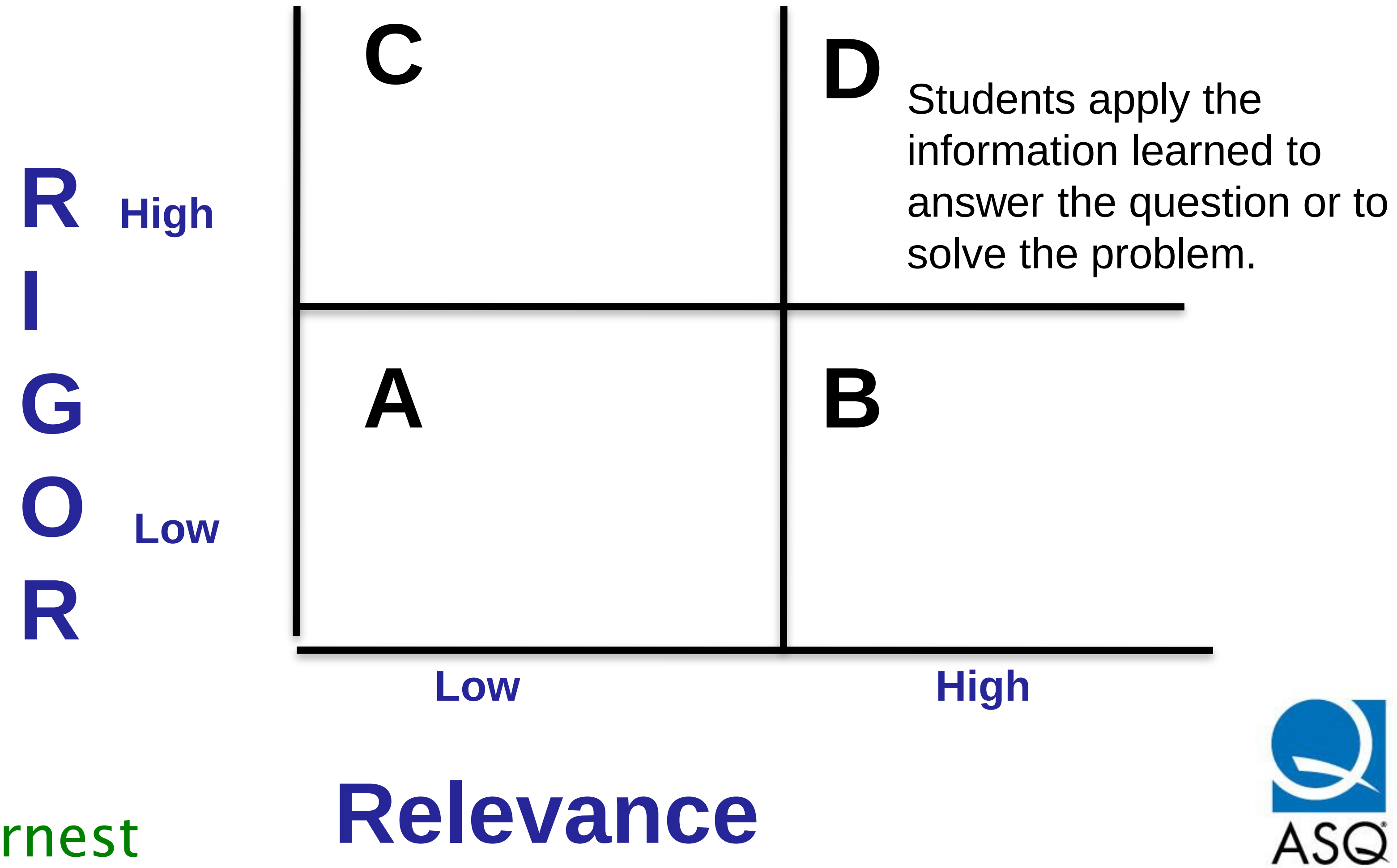
Rigor/Relevance Framework – Step 4



Rigor/Relevance Framework – Step 5



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Rigor/Relevance Framework

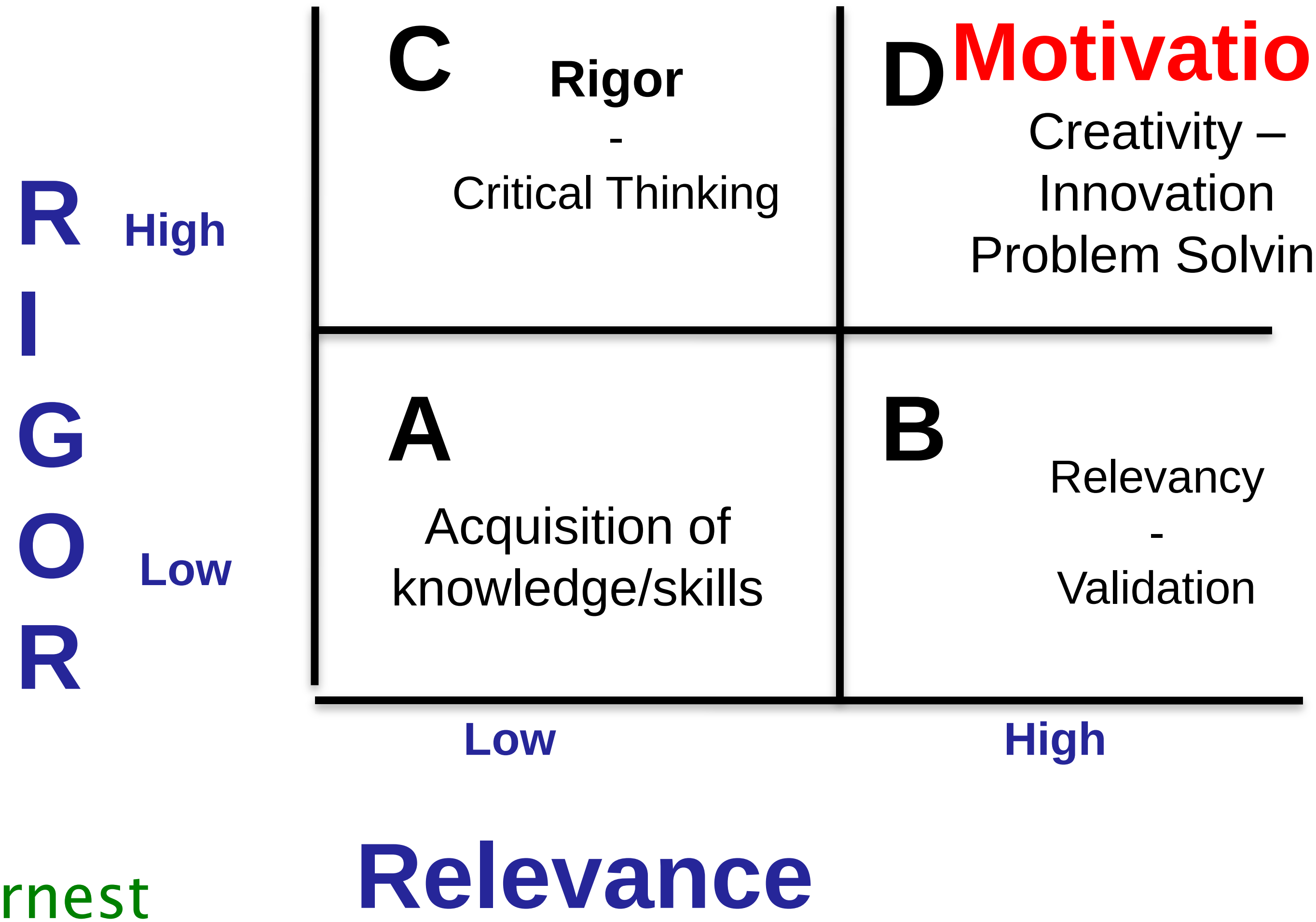
RIGOR	Low Relevance	High Relevance
High	**C** **Rigor** - Critical Thinking	**D** **Motivation** **-** Creativity –Innovation Problem Solving
Low	**A** Acquisition of knowledge/skills	**B** Relevancy - Validation

R I G O R (High / Low)

Low High

Relevance

Rigor/Relevance Framework & Motivation



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Optimal Learning Environment

Six Ideas for improving learning:

- **See the whole before practicing the parts.**
- **Study content and apply it to authentic problems.**
- **Applied Learning**
- **Active Exploration**
- **Adult Connections**
- **Make schoolwork more like real work.**

Sure as Sunlight

there's a child here in your caring
who may someday cure all cancer
but you've got to lay the groundwork
so that it can come to pass.

she's a child who hasn't blossomed
so you cannot see her brilliance
but as sure as there is sunlight
she is here now in your class.

I can't tell you what her name is
nor her height, nor weight, nor color,
only that she is potentially
a history-making lass.

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