Spring 4-2020

Can Exploratory Learning Help to Close the Minority Achievement Gap?

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INTRODUCTION

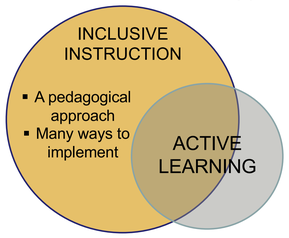
MINORITY ACHIEVEMENT GAP denotes the disparity in academic performance between underrepresented minority (URM) and non – URM students[1].

Lack of URM in STEM + URM underperforming = minority achievement gap

STEM workforces needs URM – in 2010, URM were 28.5% of the US population, and only 9.1% of Americans with STEM degrees/occupations[2].

INCLUSIVE INSTRUCTION is a pedagogical approach with many implementation strategies, one of which is active learning.

ACTIVE LEARNING engages students in learning through activities and/or discussion in class, as opposed to passively listening to lectures[4].



- High potential of being inclusive because it encourages a growth mindset and collaboration[3].
- Has been shown to decrease the minority achievement gap[5].
- Not all active learning strategies promote inclusive learning environments.

EXPLORATORY LEARNING is a type of active learning.

- Students explore a novel concept prior to instruction – has been shown to increase conceptual understanding[8] and learning[7].
- Explore phase —> Direct Instruction Phase
  - During explore phase, prior knowledge is activated and knowledge gaps uncovered, allowing problem features to be recognized[6].

HYPOTHESES

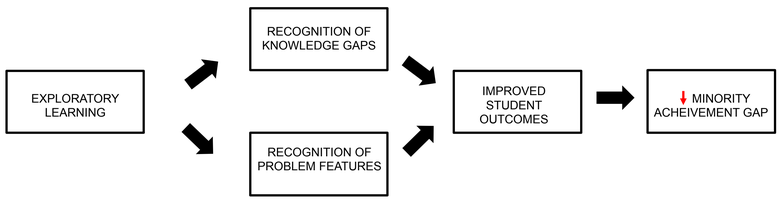
R E S E A R C H Q U E S T I O N

Can exploratory learning close the minority achievement gap?

WE HYPOTHESIZE:

1. **Students in the explore-first condition will have higher posttest scores than students in the instruct-first condition &**
2. **URM students in the explore-first condition will have higher posttest packet scores than URM students in the instruct-first condition**

M E C H A N I S M



METHODS

Secondary analysis

Participants (*N* = 356)

- PSYC 301 (Psychology statistics course) students (*n* = 265)
- Learning & Performance Lab (*n* = 91) participants
- URM (*n* = 94; 26.4%) vs Non-URM (*n* = 262; 73.6%)
- Explore-first (*n* = 174) vs Instruct-first (*n* = 180)

WEEK 1

Intervention packet

1 Explore-First condition

→ **Explore Activity**
15 minutes

→ **Instruction Activity**
15 minutes

→ **Survey**
2 – 3 minutes

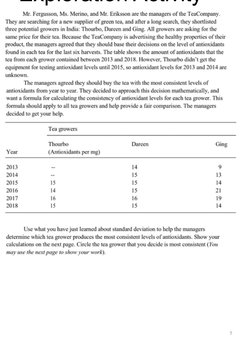
2 Instruct-First condition

→ **Instruction Activity**
15 minutes

→ **Explore Activity**
15 minutes

→ **Survey**
2 – 3 minutes

Exploration Activity



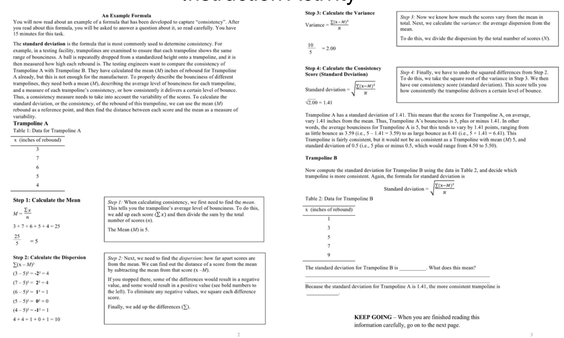
Mr. Fergusson, Ms. Morino, and Mr. Eriksson are the managers of the TeaCompany. They are searching for a new supplier of green tea, and after a long search, they shortlisted three potential growers in India: Thourbo, Dareen and Ging. All growers are asking for the same price for their tea. Because the TeaCompany is advertising the healthy properties of their product, the managers agreed that they should base their decisions on the level of antioxidants found in each tea for the last six harvests. The table shows the amount of antioxidants that the tea from each grower contained between 2013 and 2018. However, Thourbo didn't get the equipment for testing antioxidant levels until 2015, so antioxidant levels for 2013 and 2014 are unknown.

The managers agreed they should buy the tea with the most consistent levels of antioxidants from year to year. They decided to approach this decision mathematically, and want a formula for calculating the consistency of antioxidant levels for each tea grower. This formula should apply to all tea growers and help provide a fair comparison. The managers decided to get your help.

	Tea growers		
Year	Thourbo (Antioxidants per mg)	Dareen	Ging
2013	--	14	9
2014	--	15	13
2015	15	15	14
2016	14	15	21
2017	16	16	19
2018	15	15	14

Use what you have just learned about standard deviation to help the managers determine which tea grower produces the most consistent levels of antioxidants. Show your calculations on the next page. Circle the tea grower that you decide is most consistent (*You may use the next page to show your work*).

Instruction Activity



An Example Formula

You will now read about an example of a formula that has been developed to capture "consistency". After you read about this formula, you will be asked to answer a question about it, so read carefully. You have 15 minutes for this task.

The **standard deviation** is the formula that is most commonly used to *determine consistency*. For example, in a testing facility, trampolines are examined to ensure that each trampoline shows the same range of bounciness. A ball is repeatedly dropped from a standardized height onto a trampoline, and it is then measured how high each rebound is. The testing engineers want to compare the consistency of Trampoline A with Trampoline B. They have calculated the mean (*M*) inches of rebound for Trampoline A already, but this is not enough for the manufacturer. To properly describe the bounciness of different trampolines, they need both a mean (*M*), describing the average level of bounciness for each trampoline, and a measure of each trampoline's consistency, or how consistently it delivers a certain level of bounce. Thus, a consistency measure needs to take into account the variability of the scores. To calculate the variability, or the consistency, of the rebound of this trampoline, we can use the mean (*M*) rebound as a reference point, and then find the distance between each score and the mean as a measure of variability.

Trampoline A

Table 1: Data for Trampoline A

x (inches of rebound)
7
6
5
4

Step 1: Calculate the Mean

$M = \frac{\Sigma x}{n}$

$3 + 7 + 6 + 5 + 4 = 25$

$\frac{25}{5} = 5$

The Mean (*M*) is 5.

Step 2: Calculate the Dispersion

$\Sigma (x - M)^2$

$(3 - 5)^2 = -2^2 = 4$

$(7 - 5)^2 = 2^2 = 4$

$(6 - 5)^2 = 1^2 = 1$

$(5 - 5)^2 = 0^2 = 0$

$(4 - 5)^2 = -1^2 = 1$

$4 + 4 + 1 + 0 + 1 = 10$

Step 1: When calculating consistency, we first need to find the *mean*. This tells you the trampoline's average level of bounciness. To do this, we add up each score (Σx) and then divide the sum by the total number of scores (*n*).

Step 2: Next, we need to find the *dispersion*: how far apart scores are from the mean. We can find out the distance of a score from the mean by subtracting the mean from that score ($x - M$).

If you stopped there, some of the differences would result in a negative value (e.g., 3 under would result in a positive value (see bold numbers to the left). To eliminate any negative values, we square each difference score.

Finally, we add up the differences (Σ).

Step 3: Calculate the Variance

Variance = $\frac{\Sigma (x - M)^2}{n}$

$\frac{10}{5} = 2.00$

Step 3: Now we know how much the scores vary from the mean in total. Next, we calculate the *variance*: the average dispersion from the mean.

To do this, we divide the dispersion by the total number of scores (*N*).

Step 4: Calculate the Consistency Score (Standard Deviation)

Standard deviation = $\sqrt{\frac{\Sigma (x - M)^2}{n}}$

$\sqrt{2.00} = 1.41$

Step 4: Finally, we have to undo the squared differences from Step 2. To do this, we take the square root of the variance in Step 3. We then have our consistency score (standard deviation). This score tells you how consistently the trampoline delivers a certain level of bounce.

Trampoline A has a standard deviation of 1.41. This means that the scores for Trampoline A, on average, vary 1.41 inches from the mean. Thus, Trampoline A's bounciness is 5, plus or minus 1.41. In other words, the average bounciness for Trampoline A is 5, but this tends to vary by 1.41 points, ranging from as little bounce as 3.59 (i.e., 5 – 1.41 = 5.59) to as large bounce as 6.41 (i.e., 5 + 1.41 = 6.41). This Trampoline is fairly consistent, but it would not be as consistent as a Trampoline with mean (*M*) 5, and standard deviation of 0.5 (i.e., 5 plus or minus 0.5, which would range from 4.50 to 5.50).

Trampoline B

Now compute the standard deviation for Trampoline B using the data in Table 2, and decide which trampoline is more consistent. Again, the formula for standard deviation is

Standard deviation = $\sqrt{\frac{\Sigma (x - M)^2}{n}}$

Table 2: Data for Trampoline B

x (inches of rebound)
1
3
5
7
9

The standard deviation for Trampoline B is _____. What does this mean?

Because the standard deviation for Trampoline A is 1.41, the more consistent trampoline is _____.

KEEP GOING – When you are finished reading this information carefully, go on to the next page.

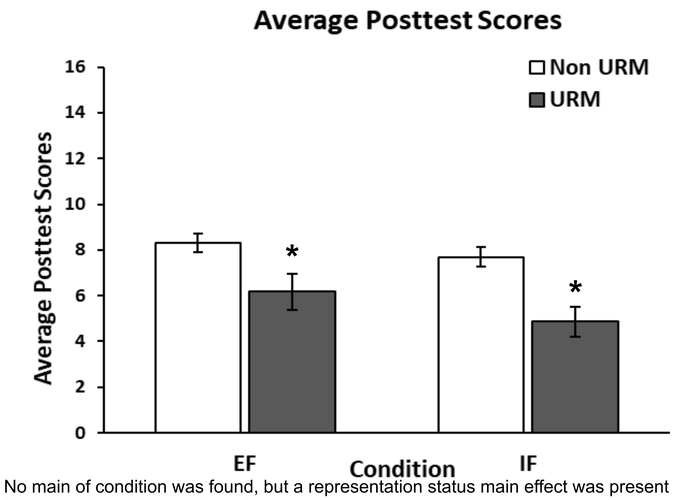
WEEK 2*

*This occurred immediately after the intervention packet for lab participants

Posttest packet

→ **Participants in both conditions were given the same posttest packet**
35 minutes

RESULTS CONTINUED



- No main of condition was found, but a representation status main effect was present
- No interaction effect was found
- An overall ANOVA with just condition showed a significant effect

DISCUSSION

Findings

Exploratory learning positively affected learning overall, but did not reduce the URM achievement gap.

Limitations

Packets lacked social factors shown to be integral to implementation, n_{URM}, one time testing

Implications

Exploratory learning could be a method to decrease the achievement gap with the right implementation

Future Directions

Different implementation strategies including collaborative exploratory learning, increase *N* and n_{URM}, real-world classroom implementation

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ACKNOWLEDGEMENTS

Any questions about this poster can be sent to: snderk01@louisville.edu or marci.decaro@louisville.edu