Why Improv is better than Textbook Roleplays in business classrooms?

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This teaching note describes how improv activities can be incorporated in business classrooms. It provides various tips to modify standard improv techniques used by business consultants and modify them to meet the student needs. The data on students' evaluation of my sales classes during 2013-2016 are provided to show how improv improved their perception of key sales techniques and concepts. The results suggest that incorporation of improv into classroom activities can lead to higher evaluation of classroom teaching which are statistically significant as well. The students' written comments also showed a positive perception of such interactive activities, along with a few comments on overcoming stage fear. Customized roleplays and improv create many teachable moments involving teamwork, building trust, and communication skills, both verbal and nonverbal (such as body language and facial micro-expressions) that may get overlooked in a traditional business class.

The importance of interpersonal communication skills have long been recognized to succeed in businesses (Adler, Elmhorst, & Lucas, 2012; Andrews & Higson, 2008). Over 80 percent of the business owners have cited that they would prefer their employees to develop better communication skills (Burgoon, Guerrero, & Floyd, 2016). To meet the needs of future employers, today's business students need to learn not only communication skills, both verbal and non-verbal, but also negotiation and soft-skills (teamwork, building trust, etc.). The business content defines 'what is said;' it is becoming important to pay attention to 'how it is said' (Burgoon et al., 2016; Mehrabian, 1972). The students need to learn and react quickly according to the changing business context, by observing the body language and facial micro-expressions to gauge a customer's interests

or objections to their product (Fast, 1988; Pfister, Li, Zhao, & Pietikäinen, 2011; Yan, Wu, Liang, Chen, & Fu, 2013).

The nonverbal and negotiation skills of communication are typically considered subliminal or 'non-content' content (Kumarappan, Hostetler, & Angles, 2014; Soloff, 1973). For instance, students typically do not get enough practice to be cognizant of such subliminal issues in communication. They are as important, if not more, as the business knowledge and other business aspects such as manufacturing or marketing. The students are often left to their own methods and devices to learn these skills through experience at internships or jobs. The commonly used interactive instruction methods in business classes such as case studies, simulations, and audio-visual aids do not always aid in learning soft-skills (Banbury & Hebert, 1992; Hays et al., 2012). Moreover, the outcome of a business dealing also depends on the personality, temperament, and approaches of the people involved. Hence, the students need to learn how to reflect and hone their personal approaches that will define their business successes (Baxter, 2009; Säilä, 2005).

As an instructor of sales classes, I am concerned with 'How to help students develop the communication skills, both verbal and nonverbal? How to prepare students to handle fluid business decisions, while helping them to become cognizant and polish/improve their personal approaches?' I have found some success using roleplays and improv presentations to teach these concepts in my classes. The roleplays are defined as interactions where two students assume the role of buyer and seller and choose their own methods of presentation and negotiation. Improv, short for improvisation methods, has also long been used in business executive

training (Keefe, 2003; Scinto, 2015). The improv activities refer to another type of interaction, where the instructor stipulates certain expectations or ground rules for interaction – for instance, compulsory use of certain words or speech patterns, presentations that incorporates dynamic stage acting, among others. This teaching note shares some tips on how they were implemented over time.

The improv activities are common in the business consulting with adults and experienced business personnel (ImprovEdge, 2018). For classroom purposes and young adult situations, the improv activities need to be modified so that the business students get a clear message regarding the communication aspects, soft-skills, and the business content or concept itself. Improv and roleplays are not just for having fun by changing the pace in the classroom; they need to serve something more valuable to be accepted by the students (Banbury & Hebert, 1992). This study uses data from five sessions of sales classes that I taught at Ohio State ATI: during fall 2016, 2015, spring 2015, free form roleplays/improv were incorporated; and during fall 2014 and 2013 a few roleplays were included, as given in the textbooks. I intend to show how roleplays/improv during fall 2016 improved student perception of sales concepts by comparing their overall course evaluation of my instruction (called Student Evaluation of Instruction, SEI, in the Ohio State University) from the previous semesters.

Traditional roleplay ideas from textbooks: The sales textbooks and business consultants encourage and use roleplays to teach sales concepts (Futrell, 1988; Moncrief, 1991; Richmond, 2010; Soloff, 1973). During 2013-2014, I tried to implement the standard roleplay ideas provided at the end of each chapter in the textbook (Richmond, 2010). Two students would try

to buy or sell a product prescribed in the book such as accounting software or some chemicals (Page & Mukherjee, 2007). My students are interested in farming and agricultural products in Ohio State ATI and these traditional roleplays had a few challenges and undesirable outcomes, as listed below.

Challenges: The products prescribed for roleplays in the textbooks might not always be obvious to my students who are mostly interested in agricultural products. The students found it difficult to think quickly on their feet, due to lack of knowledge about the product given in the roleplay in the textbooks. The additional background homework to learn about the product or industry did not yield the desired level of expertise for them to be good at selling those products. Worse, the freshmen or sophomore students, who are not yet engaged in real world business situations or transactions, found it difficult to disagree with the other roleplaying student. The roleplays mostly ended with everybody readily agreeing with each other's stance or offering, and accepting to buy the product (or service) at the end of two or three minute interaction; the sellers almost offered a price discount, even when it was not asked for. Some students tended to over-prepare resulting in canned roleplay interactions with a general failure to replicate the fluidity that commonly occurs in business negotiations.

The roleplaying students would also not reveal their real thoughts due to politeness or stage fear. While the awkward exchanges can lead to some random laughs (which is indeed an important feature to lighten up the mood), the students missed the more important nuances of soft-skills and fluid nature of business conversations. The agreement reached between two students in two minutes barely reflected the real-world interactions where the salesperson makes multiple calls and visits with the customers,

especially in the Business To Business (B2B) situations. All these shortcomings forced me to rethink and recalibrate the roleplaying activity.

Strategy #1 – Free form roleplays: In spring and fall terms of 2015, I moved away from textbook-based roleplays into general roleplays: the students were free to choose their product. I gave general suggestions such as how to incorporate story-telling, using third party references, asking questions by the salesperson in the beginning of the roleplay, and ability to control the sales conversation. Still, the student conversations ended without any serious objection by the buyer-student. To avoid it, I provided them with a point of objection before the roleplay happened. The objections could be rather straight forward and conventional such as 'price is too high' or 'quality is not up to the mark,' or very personal such as 'previous salesperson was rude' or 'I do not trust your company will honor your commitments.' I provided distinct personalities to buyers such as 'demanding, friendly, price-conscious, or unethical' behaviors.

I revealed the buyer personal preferences and objections to the buyer(s) only, which introduced an additional element of surprise for the student playing the role of the seller. These objections immediately introduced an element of spontaneity and curiosity in the roleplays. The student playing the salesperson's role was under pressure to figure out which of the objections was provided by me to deal with it effectively. The students in the audience became more engaged and inquisitive about the objections; after the roleplay, the audience would share their comments on how they would have dealt with it, and offered useful insights to the student playing the role of salesperson.

The students in the audience were also invited to answer questions such as 'if I were the salesperson, I would address this objection as…' To provide additional feedback, I started to video graph the roleplays using simple flip cameras. This provided an opportunity to discuss the students' nonverbal nuances such as body language, tone, approach, cultural sensitivity, composure, and the overall impression of the roleplay. The roleplaying participants were asked to re-enact different outcomes (conflict, or conciliatory, or indecisive). The students were also suggested to repeat the roleplays with alternative underlying tones (friendly, intimidating, urgent, and indifferent).

Discussion of body language: As part of the feedback, I discuss how the body position or stance was placed. Often, I have noticed that students would fold up their hands which signifies that the students (playing the buyer or seller role) are not open to the product being discussed. The students with their hands in their pockets or those who cover up their exposed portions of their skin in the forearms could be hiding something from the other person. If somebody places their hand on the neck (often women), that would be a signal of nervousness. Students often stand cross-legged which is a clear sign of creating a barrier between themselves and others. Often when the students are interested in buying a product, they take it in their own hands.

High and Low Power Poses: I show the TED talk on body poses and how the high and lower poses can change the perception of a buyer or seller (Cuddy, 2012). High power poses include clasping their fingers overhead, standing with a broader stance to increase the surface area, legs on the table exposing the chest area. These poses increase the testosterone

levels and reduce the cortisone (stress hormone) levels giving a mental boost to the roleplay participants. In contrast, the low power poses include sitting in cowered positions and minimizing themselves. They have exactly the opposite effect on testosterone and cortisol levels. These are many more key lessons that can be taught on the body language which is beyond the scope of this article. Interested readers are encouraged to contact the author or refer to these research articles and popular websites (Fast, 1988; IndiaBIX, 2018; Müller et al., 2013). Personally, as an instructor, I pay considerable attention to students' body posture during the class, whether they show interest by looking at the screens during lectures or they are slouched in their desks.

Discussion of and facial micro-expressions: In contrast to body language, the facial micro-expressions are very hard to explain because they happen without warning and vanishes in a few microseconds. As an instructor, I had tough time showing which expressions are important and how to interpret them. For instance, a person who will not maintain eye contact, or making a small but discernible expression with their eyebrows or lips can be crucial to gauge the real interests. These expressions not only show the interests of the buyer but also their inner perceptions. Interested readers are encouraged to refer to these useful pedagogical resources which are also employed by the business consultants (Porter, Ten Brinke, & Wallace, 2012; Stewart, Waller, & Schubert, 2009; Wezowski & Wezowski, 2012).

Strategy #2 Using Improv Setup: In fall 2016, I implemented improv activities in my classes. Improv are similar to roleplays with a few more rules for the enactment. Consider a very basic improv activity such as 'Yes, And…'

In this activity, the two actors (or students, in case of business classrooms) have to agree with each other, start each sentence with the words 'Yes, And I would like to add that….' These extra words forced students to recognize the need to build upon each other's previous utterings and build consensus (Rocco & Whalen, 2014). The improv 'Yes, And…' proved to be more interesting as a conversation between a manager and employees who are forced to develop good will and acknowledge the other person's position or thinking, and still help bring innovative ideas into the business organization. It also forced students to find alternative ways to introduce their opposing thoughts without being strategically or culturally insensitive by negating the other person. 'Yes, And…' roleplay is better between two employees working for the same business who have competing interests or agendas. Improv activities have been used by business educators and consultants to train business executives on how to improve their leadership skills and improve teamwork within their organizations (Gee & Gee, 2011; Lobman & Lundquist, 2007; McKnight & Scruggs, 2008; Rocco & Whalen, 2014). As such, improv activities would purely be acting in any context such as family or friends or strangers. To make the improv relevant for business classrooms, the improv activities for classroom instruction have to be modified. Some of these modifications are explained in table 1. My only instructions before an improv are as follow:

> (i) find cooperative solutions where the parties support each other to build trust, that benefit both (business) parties,
> (ii) think and respond quickly (on the feet) to control or support the ongoing situation/scene,
> (iii) be mindful to sell while also safeguarding an improv objective (more below), and
> (iv) remember to have fun.

I reveal the rules for that particular improv at the last minute to create additional excitement and eliminate canned presentations. I have had the biggest laughter in my classes with the most acknowledging nods during improv exercises. Improv presentations also brought out student personalities and helped discuss novel topics that otherwise would not come up in normal classroom discussions.

Implementing Improvs: There are a variety of online resources with various improv setups (Improv Encyclopedia, 2017a, 2017b; ImprovEdge). The challenge with the available resources is that they are very generic and using them to convey a specific business topic, that too in a classroom with young adults, can be challenging. The following table 1 presents a summary of how other improv methods can be incorporated to reflect business concepts. Next to each improv activity's name is a time stamp with Hyperlinks to videos that can help the reader understand how the improv should play out. This list (and links) is given here only for indicative purposes. They are neither complete nor exhaustive. The readers are welcome to contact the author for more improv suggestions for business classrooms.

Table 1: Tips to modify standard improv exercises for business classroom interactions:

Improv Exercise	Tips to Showcase the Business Concept
Yes …., and… – Each person starts the sentence in agreement by saying 'Yes,…' and then adds their perspective by saying 'And…' 1:18; 1:37	Shows how to develop consensus from opposing viewpoints; works particularly well as a conversation between the manager and the salesperson/employee with differing viewpoints. The instructor can give specific opposing

	viewpoints (manager is interested in increasing productivity; employee is concerned with safety)
Short Story Improvisation Exercise – Two students alternate telling a story in five sentences. The first sentence states the character, second states the location, third states the situation/problem, fourth amplifies the situation/problem, and the fifth and last sentence solves the problem with a solution 3:29	Short story in five sentences; the students can learn how to structure the story with inputs from the other person cooperatively. Interestingly, only the final sentence will decide what the product for sale is!
Turn a Word Into a Story* – pick a random word from a business article and use it as the subject and keyword for the improv	The word can be taken as related to a product – for instance, 'lipids' in the context of a dairy farm; this will force the students to talk about the lipid (fat) content in the milk, and help the salesperson make a better impression of his/her knowledge!
Commercial – students have to create a short infomercial that is 30 seconds long similar to the infomercials seen on the TV 1:27	This is a straightforward improv activity where students demo a product or highlight its benefits.
Asides – the buyer states something publicly, the shouts "Freeze" which makes the seller 'not move;' then the buyer him/herself states to the class what he or she really thinks about the product. Having heard this, the seller will have to change their sales strategy after the word 'unfreeze' 2:11	Student salesperson gets to react to the 'inner thoughts' of the customers. It teaches students that they have to pay attention to the inner thoughts of the buyers that may not be readily shared in a business meeting.
He Said… She Said… – while similar to 'Freeze,' the key variation is that the seller has to interpret what the buyer said by saying 'he said…' forcing the seller to interpret buyers' words and comments 1:44	Student salesperson is under more pressure to interpret things much more than in the 'Freeze' improv. Any mistakes made by the seller in interpretation can be corrected by the buyer.
Shout "More Specific" – The audience can force the buyer and seller to give more specific details about their requirements or product 1:49	Students often talk in generalities suggesting that their product is of 'high quality.' The audience can force them to talk in more with more specificities. For instance, a person selling cosmetics need to give more information on the smell, chemicals, or the type of use of the product.
Who, What, When, Where, Why 1:22	Students learn how to prepare for the basic questions that the customer might have. Additional insights can be provided on who is

	involved and why they are special. In combination with 'More Specific' improv, this can be a good exercise to get a comprehensive idea about the product for sale.
"Fortunately…, "Unfortunately… (problem), "Fortunately…(solution)" – The seller starts every sentence with the word 'Fortunately,…' and give a positive aspect of their product, while the buyer starts each sentence with the word 'Unfortunately,…' and highlight certain negative aspects 2:35	Student playing the seller role will have to overcome every single objection put forward by the buyer. It is likely to drag on with buyers focusing on the negatives and sellers insisting the positives. A good conclusion is for the buyer to say "Fortunately, I will be able to meet with you at a different time with my colleagues who can address your concerns."

* Rodgers; numbers relate to various online improv videos; readers can contact author for more improv suggestions!

Student Perceptions of Improv and Roleplay: In the Ohio State University, the students rate their instructors on ten different criteria: well organized, intellectually stimulating, instructor interested in teaching, encouraged independent thinking, instructor well prepared, instructor interested in helping students, learned greatly from instructor, created learning atmosphere, communicated subject matter clearly, and an overall score. The student ratings for my sales classes during 2013-2016 are given in table 2. The improv activities were used primarily during fall 2016, while free form roleplays were used during spring and fall terms of 2015. Before that, during fall 2014 and fall 2013, the instruction generally included lectures and traditional roleplays that were already provided in the textbook.

I use these summary ratings to evaluate whether student perceptions was significantly different in fall 2016 compared to every semester before that. Two tail t-Test statistics were computed comparing the mean scores for fall 2016 with that of each term before that (table 3). The results indicated that the student ratings improved significantly in fall 2016 compared to earlier semesters fall 2013 and 2014, which used limited roleplays from the textbook. During 2015-16, roleplays (product and presentation approach chosen by the students, not the textbook) and improv activities (product chosen by the student, interaction framework defined by the instructor) were similar in terms of student ratings with no significant differences. These results indicate that students perceived classes with roleplays and improv activities better than other learning tools in sales classrooms. There is also a need for the instructors to go beyond the

traditional roleplay ideas given in the textbooks and make an effort to help students enjoy and learn from these interactive activities.

Written comments about roleplays: Here are a few written comments about the use of roleplays and improv in my classes during fall 2013 and fall 2016. Most of the comments are positive; a couple of comments clearly mention that textbook-based roleplays were not informative.

Fall 2013 (included textbook-based roleplays): "I thought the role plays were helpful, however I felt that having us read random pieces of information insulted our intelligence."

Fall 2014 (included textbook-based roleplays):
"I hate the idea of role plays every class. I would rather learn the material."
"The role plays were a great exercise that got the students very involved."
"I enjoyed the role plays and liked when students were able to be both the seller and buyer."
"I also thought that at times role plays were taken a little too seriously especially for being our first attempts at sales."

Spring 2015 (students were able to choose their own product and presentation format for roleplays):
"The role plays really helped me learn different tricks for me to use when talking to potential customers."

Table 2: Student rating of sales class with and without roleplay and improv activities

Semester	Fall 2013		Fall 2014		Spring 2015		Fall 2015		Fall 2016	
Instruction	Lecture only#		Lecture only#		Lecture + Roleplay*		Lecture + Roleplay*		Lecture + Roleplay* + Improv	
Criteria for Evaluation	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Well organized	4.2	0.9	3.8	0.9	3.9	0.9	4.2	0.7	4.2	0.6
Intellectually stimulating	3.7	1.1	3.6	1.2	4.1	0.6	3.7	0.8	3.8	0.9
Instructor interested in teaching	4.3	0.8	4	1.0	4.2	0.6	4.4	0.7	4.4	0.6
Encouraged independent thinking	4.1	0.9	3.9	0.9	4.2	0.6	4.1	0.9	4.4	0.8
Instructor well prepared	4	1.1	3.8	1.0	4	0.9	4.2	0.7	4.2	0.9
Instructed interested in helping students	3.9	1.0	3.7	1.2	3.9	1.0	4	0.9	4	0.9
Learned greatly from instructor	3.6	1.4	3.5	1.2	3.8	1.2	3.6	1.0	3.9	0.9
Created learning atmosphere	3.9	1.0	3.6	1.0	3.9	0.9	3.8	1.0	4.2	0.7
Communicated subject matter clearly	3.8	1.1	3.4	1.2	3.7	1.0	3.7	1.1	3.9	0.8
Overall rating	3.9	1.2	3.6	1.2	4.1	0.7	3.8	1.1	4.2	0.7
Number of responses	24		33		10		22		25	
Total Number of students	30		44		15		29		28	

Included some roleplay activities provided within the textbook; *Students were free to choose their own product for roleplays, rather than replicate the roleplay ideas given in the textbook.

Table 3: Comparison of fall 2016 student ratings with previous semesters:

Term	Mean (SD)	In comparison with Fall 2016			
		Difference in mean	t-Test statistic (T)	P(T<=t) two-tail	Statistically Different from Fall 2016 student ratings?
Fall 2013	3.94 (0.21)	-0.18	-1.88576	0.075572	Yes (at 10% significance level)
Fall 2014	3.69 (0.19)	-0.43	-4.85842	0.000126	Yes (at 1% significance level)
Spring 2015	3.98 (0.17)	-0.14	-1.64485	0.118364	No
Fall 2015	3.95 (0.27)	-0.17	-1.58068	0.132376	No
Fall 2016	4.12 (0.21)	Comparison Group			

Fall 2015 (students were able to choose their own product and presentation format for roleplays):

"DO NOT get rid of the role plays! They are scary at first, but it is a chance for us to fail in a safe environment and be able to learn from our mistakes. Loved the class!"

"I found the roleplays that were presented in class very helpful but the directions as to how to approach them were a bit unclear."

"I agree that it (roleplays) is a good learning experience, however they are just too staged in the classroom."

Fall 2016 (students chose their own products; improv provided more setup):

"I really enjoyed this class, I learned a lot through the role plays and improv."

"I liked the roleplays."

Some other suggestions in implementing roleplays and improv:
- For many freshmen and sophomore students, this would be their first attempt at roleplay or improv. To quell their anxiety, I typically

award full points as long as they participate in a roleplaying or improv activity.

- To ensure that the audience are engaged, I assign two students to give feedback to the buyer and seller exclusively. Feedback can also be obtained from the classroom discussions or anonymously via clicker software such as socrative.com, getkahoot.com, or tophat.com.
- Additional discussions can center on the use of particular words, fluency, familiarity and knowledge of the product, the helping tendency and confidence displayed by the seller, and the ability of the seller to control the flow and outcome of the conversation.
- Certain business databases such as Million Dollar Database or Hoovers provide specific questions for each industry. These call preparation questions can help students reach beyond the generalities during their roleplays and ask specific questions (D&B Hoovers; dun&bradstreet and mergent).
- If time permits, the video can be replayed to highlight key points, drawing attention to the body language, facial micro-expressions, and how would those things be interpreted in the real world.

Conclusion

This teaching note summarized how improv and roleplay activities were incorporated in my business sales classes during 2013-16. The roleplay and improv activities help students learn various soft-skills such as trust, communication (non-verbal, body language, facial micro-expressions), and prepare for unanticipated, spur-of-the-moment, fluid business situations. To improve student performance in the roleplays, the instructor could coach the students (playing the buyer role) to raise objections during sales roleplays. The improv, referring to more stipulations on the use of certain words or certain style of roleplay, was also perceived favorably by the students.

The students' ratings of the sales classes showed that the combined use of improv and roleplays during fall term of 2016 was perceived differently from the earlier fall terms in 2013 and 2014 (which involved only textbook based roleplays). The statistical results confirmed that students' ratings improved with the use of roleplays and improv activities; the students were enthusiastic about their roleplays and improv activities and wrote favorably in support of improv and roleplays in the sales classes. The roleplays and improv certainly offer opportunities for instructors to create interesting and useful learning atmosphere in the business classrooms. With business coaches embracing improv exercises, it is only natural that business instructors consider improv exercises for their classroom teaching as well. Teachers need to go beyond the roleplay ideas given in the textbooks to make them relevant for students. With a bit of creativity and a willingness to accept new challenges, instructors can create tremendous learning moments through improv activities and roleplays in their business classrooms.

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Appendix

1. How old are you?

2. Gender?

3. Have you **completed** more than 30 credit hours of classes? Y/N

4. Have you **completed** more than 60 credit hours of classes? Y/N

We are going to ask the same questions about each of the classes you are taking this semester. If you aren't taking a particular class, leave those questions blank. For instance, most students take four or five classes a semester, so most students will leave questions about their sixth class blank. Make sure to look at the back of the pages too!

If you have filled this survey out in a previous class, please don't fill it out again!

1. For your **FIRST** class, please circle the type of class it is. If you class isn't specifically listed, choose the category it best matches.
   a. Accounting/Business/Economics /Organizational Leadership/
   b. Graphic Design/IT/OIS/Technical Studies
   c. Agriculture/Food Science
   d. Art/Cultural/Music/Philosophy/Theatre
   e. Communication/English/Languages
   f. Criminal Justice/Law Enforcement
   g. Engineering
   h. Math/Statistics
   i. Anatomy/Biology/Chemistry/Earth and Environmental Studies/Physics
   j. Regional Studies/Religion/Anthropology/History
   k. Political Science Psychology/Sociology/Social Work
   l. Teacher Education/Early or Middle Childhood

2. How much time outside of class on average do you spend studying for this class on a weekly basis
   when there is **not** a test that week?   _____Hours _____Minutes

   when there **is** a test that week?   _____Hours _____Minutes

3. On a scale from 1 (no anxiety) to 7 (disabling amount of anxiety), how much anxiety (nervousness or stress) did you experience before a test in this class compared to your other classes?
   1   2   3   4   5   6   7

4. Does this class offer quizzes or tests on Pilot that you can take without potentially losing any points on your final grade? _____Yes   _____No

5. If yes, do you take these practice quizzes or exams on Pilot? ____Yes ____No

6. If you take these practice quizzes or exams, do they make you more or less nervous for class exams?
   More   About the same   Less

7. If you take these practice quizzes or exams on Pilot, do they help you learn the material covered by this class? _____Yes   _____No

8. If taking these practice quizzes or exams on Pilot helped you learn this course's material, please select any of the following reasons why:
   a. They review/summarize what we went over in class
   b. They help me to prepare for what is on the class exams
   c. They are fun
   d. They make me less nervous/anxious about the upcoming class exams
   e. They keep me focused on the material/helped me pay attention
   f. They show me the correct answer
   g. They help me figure out what I know and what I don't know
   h. I don't know why I think practice quizzes help
   i. Other (please write why):

9. Was there anything about the practice quizzes you did not like, even if they helped you learn? If you didn't take practice quizzes in **this** course, leave these answers blank. Select all answers that apply.
   a. Pilot, in general, is too confusing
   b. The questions were confusing
   c. The quiz didn't give me enough time to answer the questions
   d. The practice quizzes made me nervous
   e. The practice quizzes were boring
   f. Nothing I didn't like
   g. Other (please write why):

10. What strategies do you use for **this** course when you study outside of class? Select all answers that apply.
   a. Mnemonics (rhymes, acronyms, memory tricks to help you remember things).
   b. Repeating key facts/terms over and over
   c. Using flashcards
   d. I test myself (not using flashcards)
   e. Someone else tests me (not using flashcards)
   f. Practice quizzes on Pilot, other websites, or from the textbook
   g. Reviewing materials (guides, class-packets, notes, textbook)
   h. Re-writing class notes
   i. Other (please write what other strategies you use):

Development of Student Abilities in Control of Variables
at a Two-Year College

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Scientific reasoning skills are necessary for scientific literacy. The control of variables (COV) sub skill is foundational for developing scientific reasoning skills. This study investigated student development of Low, Intermediate, and High COV skills in a first semester algebra-based introductory physics lab at a two-year college. Nine COV questions were utilized to determine students' development at the three COV skill levels. Findings indicated students' overall COV skills improved, but the increases varied according to the COV skill level assessed. These findings provide a baseline for a two-year college population for which scientific reasoning is largely unstudied. Future research will explore COV development at a four-year institution where a larger sample is available in order to inform future lab curriculum development.

Scientific reasoning (SR) is a set of abilities required to conduct scientific investigations and includes the collection and analysis of evidence, as well as the generation of evidence-based arguments (Koenig, Schen, & Bao, 2012). Some studies have shown that college students do not necessarily improve their SR skills within a one-semester physics course (Moore & Rubbo, 2012) or even over the course of their undergraduate education (Ding, 2013; Ding, Wei & Mollohan, 2016). Because a curriculum focused on content contributes little to the development of SR skills, many have called for inquiry-based science instruction that promotes the

development of SR skills (Bao et al., 2009; Ding, 2013). A curriculum that specifically targets the development of SR skills has been shown to help students improve in some areas of scientific reasoning (Koenig, Schen, & Bao, 2012).

Control of variables (COV) is a fundamental skill necessary for the development of SR skills. Chen and Klahr (1999) defined the control of variables strategy as varying one variable between experimental conditions, being able to make valid inferences from unconfounded experiments and being able to identify the indeterminacy of confounded experiments. But not all outcomes are influenced by only one variable. Kuhn, Ramsey, and Arvidsson (2015) argue that COV skills need to be developed for more complex experiments involving multiple variables that may affect an outcome. Several categories of factors can contribute to the complexity of COV skills (Zhou et al., 2016). Understanding the factors that contribute to the complexity of COV skill levels is essential for developing students' COV skills. **It is important for curriculum to focus on developing this skill at various complexity levels** (Zhou et al., 2016; Wood, 2015)**.**

Specific COV skills have been assessed for pre-college students (Chen & Klahr, 1999; Penner & Klahr, 1996; Kuhn, 2007) and college students (Boudreaux, Shaffer, Heron, & McDermott, 2008; Zhou et al., 2016) with a variety of instruments targeting individual COV skills. Lawson (1978) proposed his Classroom Test of Scientific Reasoning (LCTSR) that was revised in 2000 and has been used in a variety of classroom settings (Bao et al., 2009; Coletta & Phillips, 2005). The LCTSR measures a variety of SR skills, but only contains three COV scenarios involving designing a controlled experiment and determining if experimental results indicate variables have an impact. Based on the definition of control of variables proposed by Chen and Klahr (1999), Schwichow et al. (2016) argue for four sub categories of COV skills–designing controlled experiments, interpreting controlled experiments, identifying controlled experiments, and understanding the indeterminacy of confounded experiments. While this framework incorporates important aspects of COV skills, a finer grain is needed to distinguish the various COV skill complexity levels. Zhou et al. (2016) proposed a progression of COV skills that incorporated a variety of factors that contribute to COV complexity, including number of variables, context (real-world vs. physics context), inclusion of experimental results, testability and influence. Building on their work, we tested a set of COV questions that incorporated a wide range of COV complexity and classified their level based

on student data in a naturalistic setting (Wood, 2015).

The purpose of this study was to investigate student development of Low, Intermediate, and High COV skills at a two-year college (TYC) in an introductory physics lab course that targets the development of SR skills. The research questions were:

1. Do students' COV skills improve in an introductory physics lab course that targets the development of scientific reasoning skills?
2. At what complexity levels do students' COV skills improve?

This article discusses how the instrument used addresses the COV skill levels and the development of students' COV skill levels in an inquiry-based lab at a TYC.

Methods
Data Collection and Analysis

This study was conducted during Fall 2016 and Spring 2017 semesters in a first semester, algebra-based introductory physics lab at a Midwest two-year college (TYC). The lab met for two hours each week in a 15-week semester. The lab curriculum utilized guided-instruction that targeted the development of students' SR skills. Students were given a research question and were guided through designing and conducting controlled experiments in order to make valid claims based on experimental evidence. There were twelve labs, many which focused on one topic over two weeks. This allowed students to explore a topic using valid experimental design to create mathematical models from experimental data and then to apply their mathematical model to a similar situation. The lab topics included a Pendulum, Projectile Motion, Newton's Laws, Simple Harmonic Motion, Momentum & Energy, Rotation, and a Windmill Design Challenge.

Three full-time physics instructors taught the seven lab sections. Students in this course were predominately in the health sciences, including pre-pharmacy, pre-med and a variety of health fields. A total of 78 students were enrolled in the labs, but only 65 students completed both the pre- and post-tests and are included in this study. The pre-test was administered during the first week of the lab course prior to instruction and the same post-test during the last week of the course. The lab curriculum specifically targeted scientific reasoning skills, including COV skills (Koenig, Wood, Bao,