How Delivery Method Impacts Student Perceptions of Anxiety and Learning with Combined Muddiest Point and Peer Instruction Activities in Community College Anatomy and Physiology Classes: Lessons for Faculty, Higher Education Academic Leaders, and Educational Technology Leaders

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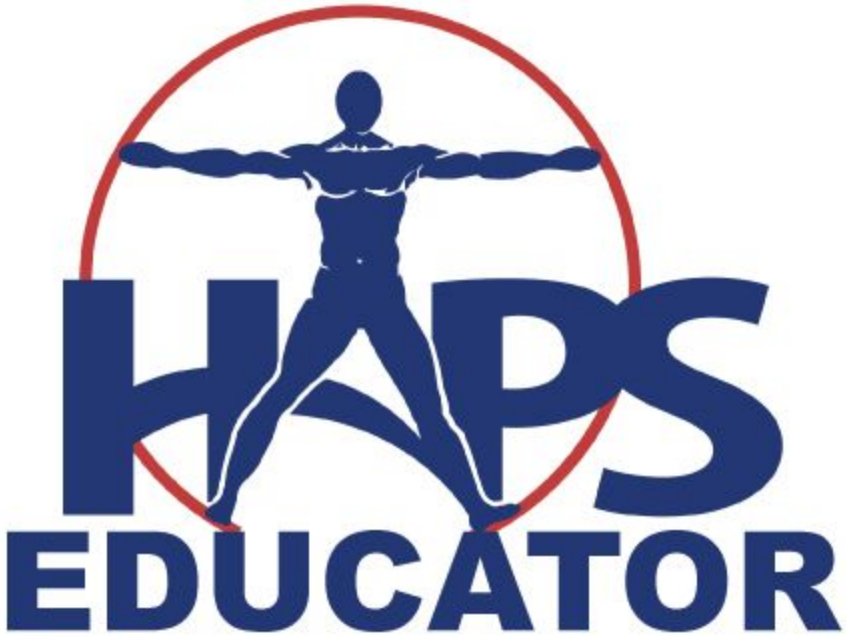

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How Delivery Method Impacts Student Perceptions of Anxiety and Learning with Combined Muddiest Point and Peer Instruction Activities in Community College Anatomy & Physiology Classes: Lessons for Faculty, Higher Education Academic Leaders, and Educational Technology Leaders

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Abstract

Muddiest point and peer instruction are evidence-based instructional practices that can be used to address student learning gaps. The purpose of this study was to determine the impact of modality (face to face or online) on student perceptions of the effectiveness of combined muddiest point and peer instruction activities in community college anatomy and physiology courses. Data was collected through end of course surveys and included quantitative and qualitative results. While there was no significant difference in student perception of anxiety or contribution to learning among face-to-face and online students, anxiety levels were low and contribution to learning was high for both groups. Both groups generally provided positive qualitative responses, but online students were more likely to provide positive feedback on muddiest point and peer instruction activities than face-to-face students. Negative responses tended to focus on wanting to work alone and dissatisfaction with classmates' contributions. This study was supported as part of the Community College Anatomy and Physiology Education Research (CAPER) project (2111119). https://doi.org/10.21692/haps.2023.023

Key words: muddiest point, peer instruction, online learning, community college, evidence-based instructional practice

Introduction

Faculty use evidence-based instructional practices like muddiest point activities to better understand where students struggle in subjects like anatomy and physiology (Hyson et al, 2021). Mackos and Tornwall (2021) found that muddiest point activities helped faculty members identify topics needing clarification in large-enrollment graduate pathophysiology courses for nursing students. Students submitted topics they didn't understand (muddiest points) and then instructors used these to provide instruction on the most difficult-to-understand topics. The muddiest points were examined by faculty inside the learning management system. Mackos and Tornwall (2021) found that examination scores where higher when the technique was used compared to scores in the year before the technique was implemented. Most students in that study indicated that identifying muddiest points and receiving targeted instruction increased their understanding of pathophysiology content.

Cooperative learning, also known as peer instruction, is another practice that has been associated with positive student achievement (Johnson & Johnson, 2009). In this technique, students learned from one another through interactive activities where one student provided information to help other students learn. Crouch and Mazur (2001) found that cooperative learning increased student learning in physics classes. While Premo and colleagues

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(2018) found no correlation between collaborative learning and student achievement, they did notice an increase in student engagement, which can be an important factor in improving retention and academic performance (Preszler, 2017).

Engagement in classes can assist students with a sense of belonging, course retention, and persistence in their respective degree program regardless of course delivery method. In their synthesis of the literature, McCutcheon and colleagues (2015) found no difference in learning among nursing students whether the learning environment was face-to-face or online. England et al. (2019) found that students who perceived the course as difficult (an indicator of anxiety) tended to not perform as well as students who didn't find the course as difficult. Sarkar et al. (2021) found that 83% of medical school students found online muddiest point activities effective. The goal of this project was to address a gap in the literature by determining if student perceptions of combined muddiest point and peer instruction activities in a community college-level anatomy and physiology course varied by delivery method and course length. This study aimed to address the following research questions:

1. *Are students' self-assessment of anxiety impacted differently when muddiest point and peer instruction activities are utilized in face-to-face vs. online anatomy and physiology courses?*
2. *Is student perception of the learning value of using both muddiest point and peer instruction impacted by delivery method (either face-to-face or online) in anatomy and physiology courses?*

Methods

Student Population

The study group consisted of students taking anatomy and physiology at a rural community college in Texas during the fall 2022 semester. Courses were taught in either a face-to-face or an asynchronous online format. Each format was either offered in a 16-week or 8-week duration. This study (IRB #1899183-1) was granted exemption from full review by the Tarleton State University Institutional Review Board along with approval from Panola College to survey students, and informed consent was obtained from all participants.

Procedure

Each week, students were assigned a muddiest point activity that was completed in an online discussion post within the learning management system (including in the face-to-face courses) where students provided their own muddiest point. As part of the activity, students identified resources to help address their muddiest point, which were also shared with other students within the discussion board activity, thus providing a level of peer instruction.

For the peer instruction/muddiest point activity, students completed online discussion posts where they provided the topic they understood least (muddiest point). Students also responded to at least two other students by providing resources that helped them better understand the concept that another student found difficult to understand.

Data Collection

Students were administered a survey at the beginning and at the end of the semester that included Likert scale questions related to perceived anxiety caused by the use of muddiest points and peer instruction activities as well as how helpful the combination of activities was to their learning. The full set of survey questions is available in the Appendix. Students were encouraged, but not required to complete the surveys. The survey also captured qualitative responses about topics including muddiest point and peer instruction activities.

Data Analysis:

Quantitative survey responses were analyzed through descriptive statistics and mixed-model analysis of variance (ANOVA). Free response questions were analyzed using content analysis (Cavanaugh, 1997). Qualitative analysis included identifying themes and coding the data by assigning responses to themes. The percentage of time that specific themes were mentioned was compared between face-to-face and online classes.

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Results

A total of 134 (out of a possible 186) participants completed the full survey at the beginning of the courses. This included 72 students in traditional, in-person sections and 62 in online sections. There were only 34 participants who completed all aspects of the end-of-term survey. Student rating of anxiety caused by combined muddiest point and peer instruction activities did not differ between face-to-face vs online sections, and also didn't change significantly over the course of the term.

Table 1 shows the mean anxiety ratings from students in response to the statement "*How much anxiety do combined muddiest points and peer instruction cause you?"* using a 5-point Likert-type scale (where 1 indicated no anxiety and 5 indicated extreme anxiety). Students in both the face-to-face and the online courses rated these combined activities as causing a low-to-moderate degree of anxiety. A mixed model ANOVA indicated that mean anxiety ratings did not differ significantly between course delivery conditions (face-to-face vs online), time of survey completion (start vs end of term), or an interaction of these variables.

Table 2 summarizes students' mean ratings in response to the prompt*: "How much did combined muddiest point and peer instruction activities contribute to your learning?".* Students responded to this question using a 5-point Likert-type scale on which 1 indicated very little and 5 indicated significantly. Overall, students rated these activities as contributing a moderate amount to their learning irrespective of course delivery mode or time of taking the survey. A mixed model ANOVA indicated no significant differences in mean ratings between course delivery conditions, time of survey completion, or an interaction of these variables.

Mean Anxiety Rating		
	Start of Term	End of Term
Face-to-face	2.3 (± 1.1)	2.3 (± 1.4)
Online	2.7 (± 1.3)	2.3 (± 1.1)

Table 1. *Mean (± standard deviation) ratings of anxiety caused by combined muddiest points and peer instruction.*

Mean Learning Contribution Rating		
	Start of Term	End of Term
Face-to-face	3.1 (± 1.2)	2.7 (± 1.4)
Online	3.3 (± 1.2)	3.5 (± 1.3)

Table 2. *Mean (± standard deviation) ratings of how much combined muddiest points and peer instruction contributed to students' learning.*

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Themes associated with "What do you like about muddiest point activities and working with peers?"

Forty-eight percent of online student comments (10/22) indicated that muddiest point activities helped them know that they weren't alone compared to 20 percent of similar comments from face-to-face students (3/15). Thirty-three percent of online students indicated that muddiest point activities provided more understanding of course material compared to 10 percent of face-to-face students. Similar percentages of online students and face-to-face students indicated that muddiest point activities provided multiple perspectives and allowed them to learn from others. These results are provided in Table 3.

	Face-to-Face (n = 15)	Online (n = 22)
Knowing I'm not alone	20%	48%
Fun	10%	0%
Multiple perspectives	30%	29%
More understanding	10%	33%
Help each other	10%	5%
Learn from others	40%	38%
Helpful	0%	5%
Not helpful	0%	5%
Don't like group activities	0%	10%
Like to help others	0%	0%

Table 3. *What do you like about muddiest point activities and working with peers?*

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Themes associated with "What do you not like about muddiest point activities and working with peers?"

Of comments made by face-to-face students addressing this question, twenty-two percent (3/14) indicated that muddiest point activities were not helpful compared to nine percent (1/13) of online student comments. Twenty-two percent of face-to-face students indicated that they didn't like working with others on muddiest point activities compared to nine percent of online students. Eleven percent of face-to-face students did not like muddiest point activities because they learned differently than other students compared to zero percent of online students. Nine percent of online students indicated that classmates put little effort into muddiest point activities compared to zero percent of face-to-face students. These results are found in Table 4.

	Face-to-Face (n = 14)	Online (n = 13)
Other students learn differently from me	11%	0%
Encourage one another	11%	0%
Help one another	11%	0%
Muddiest points not helpful	22%	9%
Nothing disliked about muddiest points and working with peers	33%	35%
Don't like working with others	22%	9%
Didn't know the information	0%	4%
Having to wait for the activity to be finished	0%	4%
Admitting weaknesses to others	0%	4%
Similarity in student responses	0%	4%
Nothing to improve upon	0%	4%
Requires too much study time	0%	4%
Little effort from classmates	0%	9%
Effort to find information	0%	4%
Activity caused overwhelm	0%	4%
Liked connecting with peers	0%	0%
Provide individual comments	0%	0%

Table 4. *Themes associated with "What do you not like about muddiest point activities and working with peers?".*

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Themes associated with "How did your instructor help you to feel comfortable completing muddiest point activities and working with peers?"

Of face-to-face student comments made in response to this question, fifty-six percent of respondents (8/15) stated that reviews for understanding (based on trends from student muddiest points) by the instructor helped them feel more comfortable completing muddiest point assignments and working with peers compared to seventeen percent (2/14) of online respondents. Eleven percent of face-to-face students stated that instructor availability helped them feel more comfortable completing muddiest point assignments and working with peers compared to zero percent of online students. Eleven percent of face-to-face students stated that motivation from the instructor as well as reminders to complete assignments helped them feel more comfortable completing muddiest point assignments and working with peers compared to zero percent of online students. Eleven percent of online students stated that respectful and helpful feedback made them feel more comfortable completing muddiest point assignments and working with peers compared to zero percent of face-to-face students. Results can be found in Table 5.

	Face-to-Face (n = 15)	Online (n = 14)
Extra credit	11%	6%
Availability	11%	0%
Motivation	11%	0%
Review for understanding	56%	17%
Not uncomfortable	11%	11%
Reminders to complete activity	11%	0%
Covering most difficult concepts	0%	6%
Opportunity to help other students helps you learn	0%	6%
Not requiring participation made students more comfortable	0%	6%
Great job	0%	6%
No one right answer	0%	6%
Helpful and respectful feedback	0%	11%
More like a conversation than an assignment	0%	6%
Didn't make me feel comfortable	0%	6%
Simple	0%	6%
Professor asked students if they have questions	0%	6%
Makes online students feel they are not alone	0%	6%
Clear instructions	0%	6%

Table 5. *Themes associated with "How did your instructor help you to feel comfortable completing muddiest point activities and working with peers?".*

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Discussion

This study has implications for institutions that offer face-to-face and online sections of anatomy and physiology and other STEM subjects. On average, students in both types of course delivery methods perceived combined muddiest point and peer instruction activities as inducing only a relatively low level of anxiety, and this perception did not differ as a function of course delivery method or time in the course. Similarly, students rated these activities as contributing in a moderate way to their learning, irrespective of course delivery method or time in the term. Student comments provided valuable insights into the features of these activities that they appreciated, as well as actionable factors that could be improved upon.

Many students provided positive feedback on the activities. Those with negative feedback often didn't like working with peers or the quality of information provided by their peers. Online students tended to have more favorable opinions of online muddiest point and peer learning activities than face-to-face students. Online students don't have the benefit of in-class activities to build community and gain feedback on misconceptions so they may find online muddiest point and peer learning activities more helpful than face-to-face students. Online students also tend to be more likely to indicate that these activities create a sense of belonging. These findings may be helpful for faculty who struggle to keep students engaged in online classes.

Given that many students struggle in online classes and that many students also struggle with anatomy and physiology, finding strategies that help students succeed in anatomy and physiology is critical to course completion and ultimately workforce development since many students take the course to become healthcare professionals. Higher education academic leaders and educational technology leaders may consider encouraging faculty to implement muddiest point and peer instruction activities, particularly for online classes.

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Anthony Edwards serves as an assistant professor of Educational Leadership and Technology and Director of Tarleton Online at Tarleton State University. Suzanne Hood serves as an associate professor of Psychology at Bishop's University. Murray Jensen is a professor of Biology Teaching and Learning at the University of Minnesota. Ron Gerrits is a Professor and Program Director at the Milwaukee School of Engineering. Melaney Farr serves as a professor of Biology at Salt Lake Community College. Chasity O'Malley is an associate professor at the Boonshoft School of Medicine at Wright State University.

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Appendix 1: Survey Questions

Q1. With which gender(s) do you identify?

1. Male
2. Female
3. Trans male
4. Trans female
5. Genderqueer
6. Non binary
7. Other
8. Prefer not to say

Q2. Please indicate your ethnicity (i.e. peoples' ethnicity describes their feeling of belonging and attachment to a distinct group of a larger population that shares their ancestry, color, language or religion)

1. White
2. Black or African American
3. American Indican or Alaska Native
4. Asian
5. Native Hawaiian or Pacific Islander
6. Other: Prefer to self-describe
7. Prefer not to say
8. Arab
9. South Asian

Q2a. If you answered 'other: prefer to self-describe' to the previous question, please enter your comments here.

Q2b. Are you of Hispanic, Latino/a/x, or of Spanish origin?

1. No, not of Hispanic, Latino/a/x, or Spanish origin
2. Yes, Mexican, Mexican American, Chicano/a/x
3. Yes, Puerto Rican
4. Yes, Cuban
5. Yes, Another Hispanic, Latino/a/x, or Spanish origin
6. Prefer not to say
7. Other: prefer to self-describe
8. Yes, Afro-Latino

Q2c. If you answered 'other: prefer to self-describe' to the previous question, please enter your comments here.

Q3. What grade (mark) do you expect to get in this class?

Q4. What is your estimated overall grade point average (GPA)?

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Q5. What is your full name? *(Please note that your name will be viewed by an independent third party, but not your instructor, and will be removed from all data prior to publication).*

Q6. Are you a first-generation college student (i.e., neither your parents nor your grandparents attended college)?

1. Yes
2. No
3. Unknown
4. I prefer not to answer

Q7. Evaluate the following classroom activities based on how much anxiety they cause you to feel (no anxiety, some anxiety, extreme anxiety, I have never tried this activity before, prefer not to say).

- Listening/watching the instructor deliver a powerpoint lecture
- Working alone to answer a question using an anonymous student response system (e.g., clicker) or an app (e.g., Tophat, Socrative)
- Working with another student to answer a question using an anonymous student response system (e.g., clicker) or an app (e.g., Tophat, Socrative)
- Volunteering to answer a question posed by the instructor
- Being asked a question by the instructor without volunteering (cold calling)
- Combined muddiest point and peer instruction activities

Q8. Evaluate the following classroom activities in terms of how much they contribute to your learning (very little, somewhat, significantly, I have never tried this activity, prefer not to say).

- Listening/watching the instructor deliver a powerpoint lecture
- Working alone to answer a question using an anonymous student response system (e.g., clicker) or an app (e.g., Tophat, Socrative)
- Working with another student to answer a question using an anonymous student response system (e.g., clicker) or an app (e.g., Tophat, Socrative)
- Volunteering to answer a question posed by the instructor
- Being asked a question by the instructor without volunteering (cold calling)
- Combined muddiest point and peer instruction activities

Q9. For the activities that you found helpful, please explain why they were helpful. Did they help you develop more effective study strategies? If so, what were those strategies?

Q10. Please indicate how much the following problems have bothered you during the past week. Mark only one box for each problem and be sure to answer all items (not at all, a little bit, somewhat, very much, extremely, prefer not to say).

- Fear of embarrassment causes me to avoid doing things or speaking to people.
- I avoid activities in which I am the center of attention.
- Being embarrassed or looking stupid are among my worst fears.

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Q11. Please indicate how strongly you agree with each of the following statements. Note that the statement "give a good account of myself" here means "to perform well". (Strongly disagree to Strongly agree)

- I am confident that I can achieve good exam results if I really put my mind to it.
- If I don't understand an academic problem, I persevere until I do.
- When I hear of others who have failed their exams, this makes me all the more determined to succeed.
- I am confident that I will be adequately prepared for the exams by the time they come around.
- I tend to put off trying to master difficult academic problems whenever they arise.
- No matter how hard I try, I can't seem to come to terms with many of the issues in my academic curriculum.
- I am convinced that I will eventually master those items in my academic course which I do not currently understand.
- I expect to give a good account of myself in my end-of-semester exams
- I fear that I may do poorly in my end-of-semester exams.
- I have no serious doubts about my own ability to perform successfully on my exams.

The following three questions also appeared in the survey completed by students at the end of the term:

- What do you like about muddiest point activities and working with peers?
- What do you not like about muddiest point activities and working with peers?
- How did your instructor help you to feel comfortable completing muddiest point activities and working with peers?

Back to TOC