

Respiratory Therapy Student Perceptions of Individual Whiteboarding in Mechanical Ventilation Education

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Abstract: *Mechanical ventilation can be challenging for respiratory therapy students because it requires students to understand complex concepts, complete calculations, and apply information to clinical situations. Individual whiteboarding was used in a beginning mechanical ventilation course to provide students with an opportunity to actively work through course material while allowing the instructor to assess understanding and provide immediate feedback. The purpose of this study was to evaluate respiratory therapy students' perceptions of individual whiteboarding as an active learning and formative assessment strategy. Students from seven cohorts over a three-year period completed an electronic survey following completion of the course. The survey included 12 Likert-scale questions and three open-ended questions. A total of 86 responses were included in the analysis. Students reported positive perceptions of individual whiteboarding, with mean scores ranging from 4.99 to 5.78 and agreement ranging from 68.6% to 98.8%. Because the survey was modified for this study, internal consistency was assessed using Cronbach's alpha ($\alpha = 0.938$). Open-ended responses identified immediate feedback, active participation, and discussion as common benefits. Students also identified pressure when sharing responses and the need for more time to work through questions as areas for improvement. Individual whiteboarding may provide a simple way to incorporate active learning and formative assessment into mechanical ventilation instruction.*

Keywords: Individual whiteboarding; Active learning; Formative assessment; Mechanical ventilation; Respiratory therapy education

1. Introduction

Active learning has been widely recognized as a teaching strategy that can increase student engagement and improve learning outcomes [1-3]. Active learning requires students to participate in the learning process rather than only receive information from the instructor. In health professions education, active learning can provide opportunities for students to apply information and develop skills needed for clinical practice.

An increased emphasis on competency-based education in healthcare has also increased the need for formative assessment within didactic courses. Formative assessment provides instructors with information about student understanding and allows feedback to be provided during the learning process [1]. However, incorporating active learning and formative assessment into the classroom can be challenging. Limited instructional time can make it difficult to assess the understanding of all students while continuing to cover required course content.

Mechanical ventilation can be a challenging area for respiratory therapy students to learn. Students must understand complex concepts, complete calculations, and apply information to patient scenarios. Providing timely feedback is important when students are learning these concepts. A teaching strategy that allows the instructor to quickly assess student understanding while involving all students in the learning process may be beneficial.

Individual mini-whiteboards have been used in educational settings as a way to provide formative assessment, encourage student participation, and provide immediate feedback. The strategy allows students to work through a question and

display their response for the instructor to review. However, limited literature describes the use of individual whiteboarding in higher education and health professions education, and little is known about its use in respiratory therapy education.

2. Literature Survey

Active learning involves students being actively engaged in the learning process rather than primarily listening to an instructor. Active learning can include activities that require students to think through problems, participate in discussions, and apply what they are learning during class [1]. Active learning has been shown to improve student performance compared with traditional lecture-based instruction. Freeman et al. [2] conducted a meta-analysis of 225 studies and found that students in active learning courses had higher examination performance and lower failure rates than students in traditional lecture-based courses. These findings support the use of active learning strategies as a way to increase student participation and engagement during instruction.

Whiteboards have been used as an active learning strategy in higher education. Inouye et al. [4] described whiteboarding as a way for students to retrieve, discuss, and apply concepts during class while allowing instructors to identify and address student misconceptions in real time. Their activities involved students working in small groups to solve physiology problems and discuss their responses. Wood and Kutcher [3] similarly used whiteboards for small-group problem solving and found that the activities made student understanding and misunderstanding more visible to instructors while also supporting peer-to-peer learning. These studies suggest that whiteboarding can provide opportunities for active

participation, problem solving, and formative assessment during class.

Formative assessment provides opportunities for instructors to identify gaps in student understanding and provide feedback to help address those gaps [5]. Morris et al. [6] emphasized that formative assessment and feedback need to be intentionally incorporated into teaching and curriculum to be effective. This requires instructors to provide opportunities in the classroom to assess student understanding and respond to that understanding during instruction. Whiteboarding provides a way to incorporate formative assessment into classroom instruction because instructors can quickly see student responses and address misunderstandings as they occur.

Although active learning and whiteboarding have been studied in a variety of educational settings, much of the existing literature focuses on group-based whiteboarding or collaborative problem-solving activities [3-4]. There appears to be less research on the use of individual whiteboards in higher education, particularly for brief responses that allow instructors to quickly assess each student's understanding.

There is also limited literature describing the use of individual whiteboarding in respiratory therapy education or in the teaching of mechanical ventilation. Individual whiteboarding may provide a simple way for students to actively work through complex problems while allowing instructors to see individual responses and provide immediate feedback. This study evaluated respiratory therapy students' perceptions of individual whiteboarding as an active learning and formative assessment strategy in a beginning mechanical ventilation course.

3. Problem Definition

Mechanical ventilation can be challenging for students because it requires them to understand complex physiological concepts, complete mathematical calculations, and apply what they have learned to clinical situations. Traditional lecture-based instruction can make it difficult for instructors to know whether students understand the material during class. Formative assessment strategies that allow instructors to quickly assess student understanding and provide immediate feedback may help address this challenge.

The purpose of this study was to evaluate respiratory therapy students' perceptions of individual whiteboarding as a strategy for active learning and formative assessment during a mechanical ventilation course.

4. Methodology

4.1 Educational Intervention

Individual mini-whiteboards were introduced during week three of the beginning mechanical ventilation course after students had been introduced to the basic concepts. Whiteboards were used in at least six of the fourteen lectures each semester. The most common uses included ventilation-related equations and scenario-based questions.

During class, questions were presented and students were asked to write their answers on their individual whiteboards and hold them up for the instructor to review. The instructor provided immediate feedback as the responses were reviewed. When an answer was incorrect, students were given the opportunity to reconsider their response and try again or wait for class discussion. Students were also often asked to pair and share with a classmate to discuss their reasoning and compare answers.

4.2 Study Design and Participants

A survey was conducted after completion of the course to evaluate respiratory therapy students' perceptions of individual whiteboarding as an active learning strategy in a mechanical ventilation course. Seven student cohorts enrolled in the same mechanical ventilation course over a three-year period were invited to participate. All cohorts had participated in individual whiteboard activities during the course.

4.3 Survey Instrument

A modified version of the Assessing Student Perspective of Engagement in Class Tool (ASPECT), a previously validated survey, was used to evaluate respiratory therapy students' perceptions of individual whiteboarding activities during a mechanical ventilation course [7]. The original survey was developed to evaluate students' perceptions of a group active learning activity. Survey items were modified to reflect the individual whiteboarding format and the instructional setting of the mechanical ventilation course. Items referring to group activities were reworded to reflect individual whiteboarding, while the underlying concepts of engagement, understanding, confidence, instructor support, and activity preference were retained.

Ten questions were adapted from the original survey, including questions related to student engagement, understanding, confidence, peer discussion, instructor availability, enjoyment, and preference for the activity. Two additional questions were added to address students' comfort with sharing responses and their perception of receiving immediate feedback during whiteboarding activities. Open-ended questions were also added to allow students to describe what they found helpful, identify aspects they found confusing or unhelpful, and provide suggestions for improving the whiteboarding experience. The final survey included 12 Likert-scale questions and three open-ended questions. The Likert-scale questions used a 6-point scale ranging from strongly disagree to strongly agree.

4.4 Data Collection

The survey was administered electronically using Qualtrics from January 29 through March 5, 2026. Ninety-eight students were provided with a link to the survey, and informed consent information was provided on the first page. Students who agreed to participate then completed the survey. A total of 92 students accessed the survey. One student declined participation after reviewing the informed consent information, and four students provided consent but did not complete any survey items. One additional submission was removed because it was a duplicate submission from a student

who immediately recognized that the Likert scale had been answered incorrectly and completed the survey again. A total of 86 unique responses were included in the final analysis.

4.5 Ethical Considerations

Institutional Review Board (IRB) approval for this study was determined to be exempt. Participation was voluntary, and informed consent was obtained electronically through Qualtrics before students could access the survey.

4.6 Data Analysis

Quantitative survey responses were analyzed using descriptive statistics. The mean, standard deviation, and percentage of agreement were calculated for each of the 12 Likert-scale questions. Percent agreement included responses of agree and strongly agree. Internal consistency of the 12 Likert-scale questions was evaluated using Cronbach's alpha. Qualitative responses to the open-ended questions were reviewed by the primary investigator and grouped according to recurring ideas and similar concepts to identify common themes. Four themes were identified through this descriptive review of the responses.

5. Results and Discussion

5.1 Quantitative Results

Quantitative survey results are presented in Tables 1–5. The mean and standard deviation (SD) were calculated for each Likert-scale question. Responses were scored from 1 (strongly disagree) to 6 (strongly agree). Agreement represents the percentage of students who selected Agree or Strongly Agree. Internal consistency of the 12 Likert-scale questions was assessed using Cronbach's alpha calculated using Jamovi (version 2.7).

Table 1: Engagement and Effort

Question*	Mean	SD	Agreement (%)
Q1. Focus during whiteboarding	5.41	0.8	90.7
Q2. Active work with material	5.57	0.79	91.9

Table 2: Learning Process and Understanding

Question*	Mean	SD	Agreement (%)
Q3. Increase understanding	5.41	0.86	88.4
Q4. Explain thinking	5.42	0.89	91.9
Q5. Classmate explanations	5.16	1.07	77.9

Table 3: Confidence and Comfort

Question*	Mean	SD	Agreement (%)
Q7. Confidence in understanding	5.29	0.82	87.2
Q8. Comfort sharing responses	4.99	1.16	68.6

Table 4: Instructor Support and Feedback

Question*	Mean	SD	Agreement (%)
Q9. Instructor availability	5.78	0.64	98.8
Q10. Immediate feedback	5.34	0.98	84.9

Table 5: Preference and Enjoyment

Question*	Mean	SD	Agreement (%)
Q11. Enjoyment	5.21	1.11	79.1
Q12. Preference for whiteboarding	5.22	1.03	81.4

*Question wording has been abbreviated for presentation. Full survey questions are provided in Appendix A. Agreement represents responses of agree or strongly agree.

Because the validated survey was modified for use in this study, Cronbach's alpha was calculated to assess the internal consistency of the 12 Likert-scale questions. The modified survey demonstrated excellent internal consistency (Cronbach's $\alpha = 0.938$). Overall, students reported positive perceptions of individual whiteboarding activities. Mean scores ranged from 4.99 to 5.78, while agreement ranged from 68.6% to 98.8%. The highest level of agreement was reported for Q9, with 98.8% of students agreeing or strongly agreeing that the instructor was available to answer questions. The lowest level of agreement was reported for Q8, with 68.6% of students agreeing or strongly agreeing that they felt comfortable sharing their responses.

5.2 Qualitative Results

The three open-ended questions were reviewed for common themes. Four main themes were identified: immediate feedback, active participation, discussion and explanation, and challenges and suggestions for improvement.

Immediate Feedback

Immediate feedback was one of the most common things students identified as helpful. Students liked being able to see if their answer was correct, receive feedback, and work through what they had missed.

"The most helpful part was being able to write down my thoughts/answers and getting immediate feedback from the instructor."

Another student said:

"Being able to write out answers, and rework through what was wrong versus what was right."

Active Participation

Students also reported that whiteboarding helped them stay involved and required them to actively work through the material. Several students mentioned that they had to think through the questions rather than just listen to a lecture.

One student stated:

"I couldn't hide behind anyone. I HAD to participate and it really made me confront what I didn't know."

Other students described the activity as helping them stay focused and think through problems.

Discussion and Explanation

Students also identified discussion with classmates and explaining or hearing explanations as helpful. Several students mentioned that writing out their thinking and discussing answers helped them better understand the material.

One student described the benefit as:

"Being able to discuss the answers and how we got to that answer."

Students also mentioned the visual and hands-on aspects of whiteboarding. One student stated:

"I am a visual learner so seeing and writing the topics down helped me digest the material better."

Challenges and Suggestions for Improvement

Although many students did not identify anything they would change, some students described feeling pressure when answering questions in front of classmates. Some students also felt they needed more time to think through their answers before responding.

One student commented:

"It can feel like a lot of pressure to get the answer correct quickly."

Other suggestions included allowing more time to work through questions, using more clinical scenarios, providing more explanation before moving on, and incorporating additional opportunities to use whiteboarding. Some students also suggested occasional group activities or minor changes to the whiteboards and supplies.

5.3 Discussion

The results of this study showed that respiratory therapy students had positive perceptions of individual whiteboarding during a beginning mechanical ventilation course. Students reported that whiteboarding helped them stay focused, work through the course material, and improve their understanding. These findings are consistent with previous research supporting active learning and the use of whiteboarding to increase student participation and make student understanding more visible to instructors [1-4].

Previous studies using whiteboards have primarily involved students working in groups and solving more complex problems [3-4]. In this study, students used individual whiteboards to provide brief responses during lecture. This allowed the instructor to quickly see each student's response and provided an opportunity to identify areas where additional explanation was needed. Immediate feedback was one of the most common benefits identified by students in the open-ended responses. This supports the use of individual whiteboarding as a simple way to include formative assessment and feedback during classroom instruction [5-6].

Although the overall results were positive, comfort with sharing responses had the lowest agreement of the 12 questions at 68.6%. Some students described feeling pressure when answering in front of classmates or when they felt they needed to answer quickly. While individual whiteboarding gives every student an opportunity to participate, sharing responses in front of the class may still be uncomfortable for some students. Allowing students enough time to work through questions and reminding students that incorrect answers are part of learning may help with this.

Individual whiteboarding is also relatively simple to use in an existing classroom and does not require additional technology. In a respiratory therapy course such as

mechanical ventilation, it provides a way for students to actively work through calculations and clinical questions while allowing the instructor to quickly assess understanding. This study was limited to one respiratory therapy program and one mechanical ventilation course and focused on student perceptions rather than objective measures of learning. The survey was also modified from a previously validated instrument. Although the modified survey demonstrated excellent internal consistency, the modified instrument has not been independently validated.

6. Conclusion

Individual whiteboarding was positively received by respiratory therapy students in a beginning mechanical ventilation course. Students reported that the activities helped them stay focused, work through course material, and receive immediate feedback. Individual whiteboarding may be a simple and practical way to incorporate active learning and formative assessment into respiratory therapy education.

7. Future Scope

Future research should examine whether individual whiteboarding improves objective measures of student learning and performance. Research using individual whiteboarding in other respiratory therapy courses and programs may also help determine whether the approach is useful in other areas of respiratory care education. The use of individual whiteboarding in other STEM and health professions courses could also be explored.

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Appendix A. Modified Survey Instrument

The following survey was administered electronically using Qualtrics after completion of a beginning mechanical ventilation course

Survey Instructions

The following questions ask about your experiences using whiteboards during a beginning mechanical ventilation course. Please answer each question based on your own experience in this course. There are no right or wrong answers. Your responses are anonymous and will be used only for research purposes.

For the first set of questions, indicate how much you agree or disagree with each statement using the scale provided (1 = Strongly Disagree to 6 = Strongly Agree). The final questions allow you to provide written feedback.

Response Scale

- 1- Strongly Disagree
- 2- Disagree
- 3- Somewhat Disagree
- 4- Somewhat Agree
- 5- Agree
- 6- Strongly Agree

Likert-Scale Questions

- Q1. I was focused during whiteboarding activities.
- Q2. Whiteboarding activities required me to actively work through the material.
- Q3. Whiteboarding activities increased my understanding of the course material.
- Q4. Explaining my thinking during whiteboarding activities improved my understanding of the material.
- Q5. Hearing explanations from classmates during whiteboarding activities improved my understanding of the material.
- Q6. Discussion with classmates during whiteboarding activities contributed to my understanding of the course material.
- Q7. I felt confident in my understanding of the material after whiteboarding activities.
- Q8. I felt comfortable sharing my responses during whiteboarding activities.
- Q9. The instructor was available to answer questions during whiteboarding activities.
- Q10. I received more immediate feedback during whiteboarding activities than in standard classroom instruction.
- Q11. I enjoyed participating in whiteboarding activities.
- Q12. I would prefer a course that includes whiteboarding activities over one that does not.

Open-Ended Questions

- Q13. What aspects of whiteboarding did you find most helpful for your learning?
- Q14. Were there any parts of whiteboarding activities that you found confusing, frustrating, or unhelpful? If yes, please explain.
- Q15. Any suggestions to improve the whiteboarding experience?

Note: Survey instructions have been slightly edited for presentation in the manuscript. The survey was administered electronically using Qualtrics.