2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
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ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION
Paper ID #50117

Replacing Traditional Exams with Group Quizzes in a Mechanics of Solids Course (Case Study)

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Abstract:

This Case Study examines the replacement of traditional high-stakes examinations with a group quiz system in a core Mechanics of Solids course at the University of Akron. The change was motivated by persistent challenges associated with individual timed exams, which often create heightened test anxiety and reduce student engagement. To address these issues in Mechanics of Solids, eleven group quizzes were integrated throughout the semester and administered immediately following lecture and homework on each major topic. The quizzes were intentionally designed to be more complex than standard exam questions, requiring students to collaborate, articulate reasoning, and negotiate solutions, thereby reflecting teamwork practices common in professional engineering contexts.

Student responses to the group quiz format were favorable. Course evaluations reflected improved student perceptions of how assessments reinforced recently covered course material. A supplemental preference survey revealed that 57% of students favored group quizzes over traditional exams, while 39% preferred a hybrid approach that combined traditional exams with intermittent group quizzes. Qualitative feedback highlighted reduced anxiety, strengthened teamwork skills, and a more balanced workload. Individual accountability was maintained through required homework and a summative assessment in the form of a final exam.

The case study discusses both benefits and challenges encountered. Reported benefits included stress reduction, enhanced peer-to-peer learning, and the development of collaboration skills consistent with ABET outcomes. Observed challenges included uneven participation within groups and balancing academic rigor with collaboration. Lessons learned will be presented, along with strategies to mitigate group imbalances and support equitable learning.

This paper contributes to ongoing discussions about alternative assessment methods in civil engineering education. The group quiz model demonstrates a scalable, replicable approach that can reduce exam-related anxiety while promoting collaboration and deeper engagement with technical content. It offers practical insights for civil engineering educators seeking assessment strategies that balance rigor, fairness, and student well-being.

Keywords: Active Learning, Group Work, Student Assessment, Test Anxiety

Introduction

Traditional engineering courses often follow a familiar sequence of lectures, worked examples, homework, and high-stakes exams. While these exams are intended to measure mastery, they can account for as much as 80% of a student's grade [1-4], creating significant pressure to perform. The individual, time-constrained format of traditional exams contributes to test anxiety, with

roughly 75% of students reporting elevated stress levels that can impair both mental health and performance [5-7].

Active learning strategies have been shown to improve comprehension and engagement in engineering courses [8], and group work in particular enhances teamwork and communication, skills central to ABET outcomes and professional practice [9-11]. Despite this, assessment methods in many programs continue to emphasize individual testing rather than collaborative problem-solving.

This case study examines an alternative approach implemented in a core civil engineering course at the University of Akron, replacing traditional exams with a series of collaborative group quizzes. The method was designed to reduce stress, promote active engagement, and develop teamwork skills without sacrificing rigor. The following sections describe the structure of the course, summarize student responses, and share lessons learned from this experience.

Method

The group-quiz approach was implemented in the Mechanics of Solids course at the University of Akron as a structured replacement for traditional examinations. Quizzes were conducted immediately after a topic's lecture, example problems, and homework submission, allowing students to reinforce concepts through collaborative application. This timing fostered active learning consistent with studies linking engagement and satisfaction to interactive classroom practices [8, 9].

Each quiz problem was intentionally more challenging than those found on traditional exams, requiring students to combine multiple concepts and apply them to engineering scenarios. Each group quiz was administered during a full class period and consisted of a single, in-depth, open-ended, calculation-based problem, requiring sustained collaboration and discussion throughout the session. The quizzes were conducted in a closed-book and closed-notes format; however, a standard equation sheet was provided to ensure that the focus remained on problem-solving strategy and conceptual understanding rather than memorization. This structure emphasized reasoning, explanation, and group consensus, skills that promote higher order thinking in line with educational best practices [12]. To ensure fairness and accountability, students completed individual homework prior to each quiz, which helped prepare them for meaningful participation. Collectively, the group quizzes accounted for approximately 40% of the total course grade, replacing traditional midterm examinations. The semester concluded with a comprehensive individual final exam to verify that each student independently achieved course learning outcomes. The format and expectations of the individual final exam were communicated to students throughout the semester to ensure familiarity with traditional high-stakes assessment.

Students formed self-selected groups of three to four, producing approximately sixteen groups in a class of fifty-one. Each group quiz was conducted over the full 50-minute class period, during which students worked collaboratively to solve a single open-ended, calculation-based problem that exceeded the complexity of standard exams, promoting peer discussion and critical thinking. Although the quiz problems exceeded the complexity of typical exam questions, the extended class period and collaborative format allowed students sufficient time to reason through the problem

collectively and reach a complete solution. Instructor interaction during quizzes was limited to clarifying procedural questions and observing group dynamics, with no direct guidance provided on solution strategies to ensure consistent and equitable treatment across all groups. To maintain focus on analytical reasoning, the quizzes were administered in a closed-book and closed-notes format, with students limited to an equation sheet, a calculator, and standard writing materials.

Each instructional module followed a consistent sequence of lectures, examples, homework, and an in-class group quiz. Eleven quizzes were given throughout the semester, covering topics from basic stress analysis through combined loading and column design. This repeating cycle established a predictable rhythm that supported collaboration and formative assessment while maintaining academic rigor. The concluding individual exam provided a summative measure of overall mastery and ensured that group collaboration complemented, rather than replaced, individual understanding.

Results

Student reception of the group-quiz format was overwhelmingly positive. End-of-semester course evaluations rated the category "Exam's relationship to content and emphasis of course" at a mean of 4.77 on a 5-point scale (SD = 0.60, CV = 0.13), indicating strong agreement that the assessment approach aligned well with course objectives.

Qualitative feedback reinforced this sentiment. Several students highlighted how the frequent group quizzes reduced anxiety and promoted understanding through collaboration. One student commented, "I really liked the group quizzes, they helped strengthen my ability to work in groups and took away a lot of my test anxiety." Another reflected, "Having homework due and group quizzes often made the class much more manageable and less stressful throughout." Many students emphasized appreciation for the course structure itself, noting that the smaller, topic-focused quizzes created steady progress and confidence rather than pressure from only a few high-stakes exams.

Not all feedback was purely positive, but even suggestions carried an overall tone of support for the format. One student wrote, "I loved the group exams, it's an amazing idea. Maybe include more equation sheets with examples for some topics." Others echoed similar thoughts, expressing that the approach made the course "more supportive," "less stressful," and "helped me understand the material and feel confident in my abilities."

A supplemental preference survey conducted after the course further reflected this positive reception. When asked to choose between traditional exams, the group-quiz format, or a combination of both, 57 % of students preferred group quizzes, 39 % favored a hybrid model, and only 4 % preferred traditional exams (Figure 1). These results demonstrate a clear majority preference for the collaborative approach, with many students citing reduced stress and improved engagement as primary reasons for their choice.

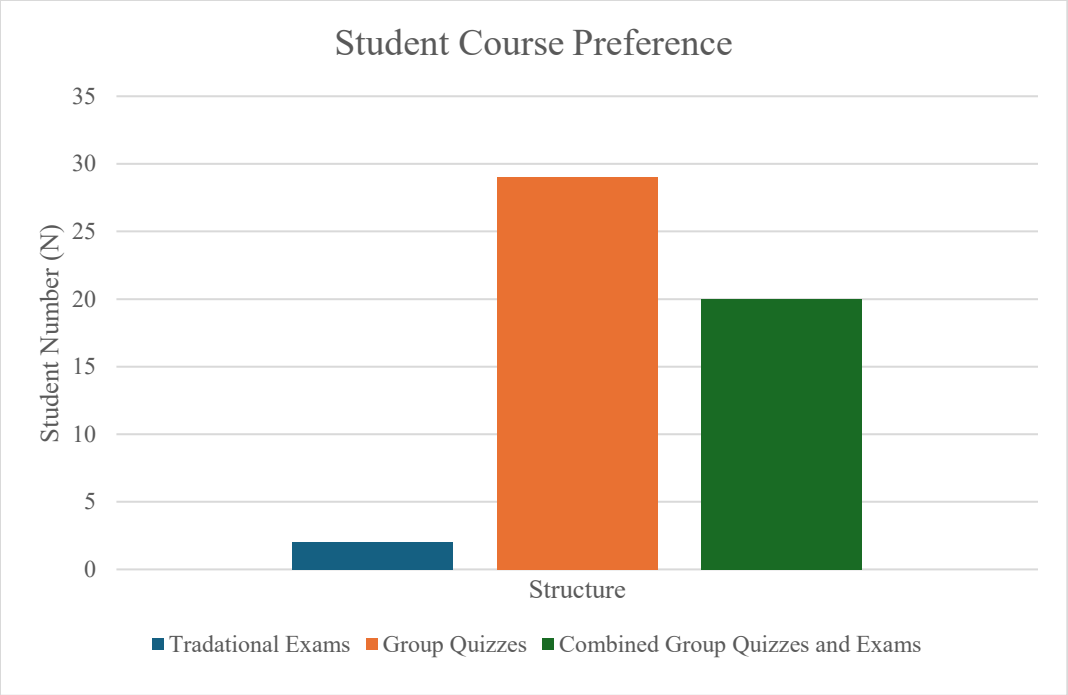

Figure 1. Student preferences for assessment format (n = 51).

Discussion

The implementation of the group-quiz approach in the Mechanics of Solids course at the University of Akron represents a meaningful shift in assessment philosophy within engineering education. Traditional exams, while effective in measuring individual performance, often create high-pressure conditions that can heighten anxiety and limit true comprehension. The group quizzes directly addresses these challenges by fostering collaboration, reducing individual pressure, and encouraging active participation in problem-solving.

Instructor observations during the semester supported these impressions. Class engagement was higher on quiz days, and students often arrived more prepared than usual. During group quizzes, discussion and collaboration were constant, with students regularly explaining their reasoning, asking clarifying questions, and checking one another's assumptions, behaviors rarely seen during individual testing. This environment appeared to encourage a culture of peer accountability and collective learning.

Impact on Learning Outcomes

From the instructor's perspective, the group-quiz model promoted deeper engagement with course material. Students collaborated on intentionally challenging problems, discussing multiple strategies before reaching consensus. This process required them to articulate reasoning clearly and listen to peers, strengthening individual understanding while reinforcing teamwork. The activity closely resembled professional engineering practice, where effective communication and joint problem-solving are essential for success.

Stress Reduction and Student Well-Being

Student feedback reflected lower levels of stress and anxiety compared with traditional exam formats. Many students described the group setting as supportive, noting that shared responsibility allowed them to focus on understanding the material rather than the pressure of individual performance. From an instructional standpoint, this environment made assessments more constructive and less intimidating, contributing to a calmer, more confident classroom dynamic.

Peer-to-Peer Learning and Skill Development

The group-quiz approach encouraged peer-to-peer learning. Within each group, students regularly compared methods and shared insights, enabling those with different strengths to help one another. This exchange not only deepened technical understanding but also built confidence in articulating engineering concepts aloud. Based on instructor observations during in-class group quizzes, students appeared to grow more comfortable communicating ideas, delegating tasks, and resolving disagreements, skills that reflect the collaborative competencies emphasized in ABET outcomes and professional engineering practice.

Scalability and Applicability to Other Courses

Although this case study focuses on a single course, the group-quiz model could be readily adapted to other engineering subjects with similar structures. The alternating cycle of lecture, homework, and collaborative assessment provided a consistent rhythm that could work equally well in courses such as statics, structural analysis, or materials. Because the framework is straightforward and low-cost, it offers an accessible way for instructors to integrate active learning without major course redesigns.

Limitations, Challenges, and Lessons Learned

While the outcomes of the group-quiz approach were largely positive, several limitations and implementation challenges were observed. Uneven participation within groups occasionally occurred, particularly early in the semester, with some students assuming more dominant roles while others contributed less. This imbalance improved as expectations were clarified and group membership was adjusted. Individual accountability was maintained through required individual homework and a comprehensive final exam, reducing the likelihood that students could rely solely on peers without developing their own understanding. While no specific accessibility challenges were observed during implementation, future iterations of this approach could more intentionally consider strategies to support students who may experience difficulty focusing or hearing in highly collaborative classroom environments. Future implementations could incorporate brief peer evaluations or reflection activities to further encourage balanced participation and accountability.

Developing effective group quiz questions also required careful planning. Quiz problems needed to be sufficiently complex to benefit from collaboration while remaining solvable within a single class period, which required more preparation time than traditional exams. Additionally, facilitating productive collaboration during quizzes required active instructor involvement to monitor group dynamics and guide discussion. Despite these challenges, the ability to observe student reasoning in real time and address misconceptions immediately was a significant instructional advantage.

Several key lessons emerged from this implementation. Clear communication of expectations early in the semester was essential for fostering productive collaboration, and maintaining a consistent rhythm of lecture, homework, and group assessment helped students prepare effectively while reducing anxiety. Preserving individual accountability through homework and a comprehensive final exam ensured that collaboration complemented, rather than replaced, individual learning. Overall, these lessons indicate that while group quizzes require thoughtful design and facilitation, they offer a practical and effective alternative assessment strategy in civil engineering education.

Conclusion

Replacing traditional individual exams with group quizzes created a more collaborative, engaging, and supportive classroom environment while maintaining academic rigor. Students reported lower stress levels, greater confidence, and stronger engagement with course material, while Instructor observations indicated more frequent conceptual discussion during class and more consistent preparation for collaborative problem-solving activities.

This case study illustrates how a simple change in assessment structure can meaningfully influence both learning outcomes and student well-being. The group-quiz model emphasizes teamwork, communication, and problem-solving, skills essential to civil engineering practice and consistent with ABET learning outcomes. Because the approach is low-cost and adaptable, it can be implemented easily in other engineering courses without major changes to course design.

Continued refinement of this model will focus on encouraging balanced group participation and evaluating the lasting impact of collaborative assessments on students' learning and professional development. As demonstrated through this implementation, fostering cooperation in assessment can enhance not only student performance but also the overall learning experience in engineering education.

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