



Feasibility and effectiveness of group exams in mathematics courses

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Motivation and background

We use group work in our classes. Should we introduce it into our assessments?

One model that has been used are so-called **two-stage assessments**, which consist of the following two stages:

Stage 1 Individual: standard formal assessment.

Stage 2 Group: students revisit the same/similar problems in small groups.

Exam grade = maximum (~ 80% individual + ~ 20% group, 100% individual)

Over 100 UBC courses use two-stage exams as high-stakes exams (midterm/final), across various disciplines.

Previous research showed:

- short-term learning gains on exact questions in Earth and Ocean Science at UBC (Gilley and Clarkston),
- no long-term learning gains on near-transfer questions in Physics at UBC (Ives),
- long-term learning gains for high-performing students in Biology at UBC (Cooke),
- students' perspectives on group exams.

So far, all the studies used multiple-choice questions only and none were in math, particularly in a first-year service calculus course.

Implementation

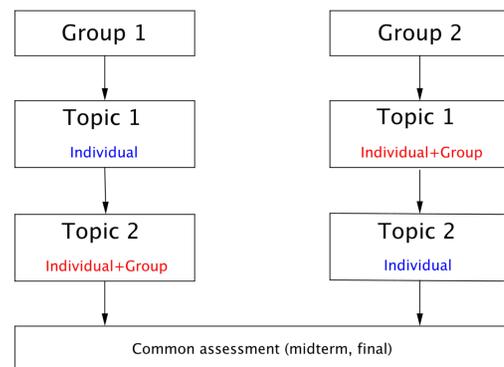
Who? Math 102 (309 students) and Math 221 (525 students).

What? Introduced two-stage quiz format during bi-weekly quizzes in both courses.

How long? Math 102: 15+10 minute quizzes; Math 221: 30+20 minute quizzes.

How much? Math 102: as above; Math 221: 50% individual + 50% group.

Why? Study long-term retention using a cross-over design:



Why? Study perspectives and benefits for students and instructors.

Why? Examine the feasibility of the assessment format in a large math class.

Immediate improvement

Math 102 quizzes
(multiple choice and short answer)

Quiz	Individual	Group
Q1	85%	85%
Q1	80%	-
Q2	75%	-
Q2	64%	83%
Q3	56%	89%
Q3	61%	-
Q4	64%	-
Q4	64%	75%
Q5	83%	89%
Q5	77%	-

Math 221 quizzes
(all multiple choice)

Quiz	Individual	Group
Q1	76%	85%
Q1	59%	80%
Q2	62%	77%
Q2	63%	70%
Q3	63%	78%
Q3	66%	-
Q4	57%	-
Q4	56%	73%
Q5	75%	78%
Q5	73%	-
Q6	60%	-
Q6	56%	68%

Analysis of question type and group composition

Results on two short answer question (out of 3 points)

	Q1	Q2
Average on individual	53%	82%
Average on group	85%	88%
	# groups	# groups
higher than top individual	16	2
equal to top individual	33	31
less than top individual	5	11
total	54	44

Results on three multiple choice question

	Q1	Q2	Q3
Average on individual	18%	48%	83%
Average on group	76%	73%	98%
	# groups	# groups	# groups
higher than top individual	7	3	3
equal to top individual	29	38	40
less than top individual	6	4	1
total	45	45	44

Results on a 5-question multiple choice quiz (identical individual and group parts)

119 people total, 44 groups
 Average on individual: 48%
 Average on group: 70%
 3 groups with no perfect individual scorer obtained a perfect score as a group

Question	Individual	Group
Q1	81%	96%
Q2	35%	45%
Q3	21%	33%
Q4	76%	94%
Q5	31%	78%

	# groups
higher than top individual	15
equal to top individual	13
less than top individual	8
total	44

Long-term retention

Analyses of the midterm and final exam questions in Math 102 and Math 221 do not show improved long-term material retention by the experimental groups.

Splitting the students into low, medium and high performing students also does not yield consistent retention benefits for any of the groups.

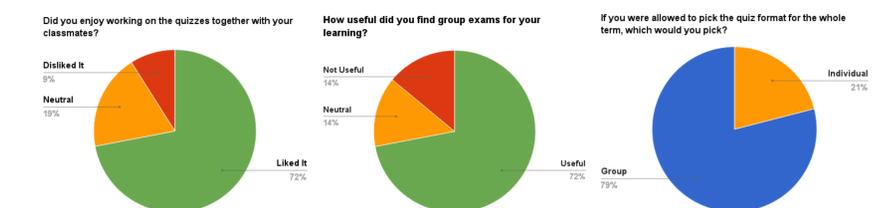
Final exam data from Math 221

Bold indicates the questions corresponding to group treatment on the quiz.

Questions	Q1	Q2	Q3	Q4	Q5	Q6
Section 1	61.3	55.7	70.6	72.5	30.3	27.7
Section 2	68.5	63.9	77.7	78.1	32.3	35.9

Student feedback

Results are based on 452 responses (54% of all students).



[Interesting fact: answers distribution was identical for Math 102 and Math 221 students, which represent two very different demographics.]

Group exams are:

- “a chance to see how your peers are approaching the concepts in class and LEARN from them (if you are struggling) or lend them GUIDANCE (if they are struggling).” [Collaborative]
- “good for instant feedback and slightly depressing because of it.” [Instant feedback]
- “a good way to expand on how you solve a question. Working with other people provides an opportunity to gain a different perspective in understanding a concept.” [Different approaches]
- “awesome because they boost your quiz mark.” [Grade booster]
- “helpful but chaotic.” [Disorganized]
- “beneficial if everyone kind of knows the material. However, sometimes people confuse each other and some with wrong voice their opinion louder and it's not helpful.” [Group dynamics]

Things to consider

- Exam composition: length, creation time, question types (multiple choice versus short answer, potential higher difficulty level for group part).
- Class time taken up by assessment.
- Administrative and TA support: invigilation, marking, recording.

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