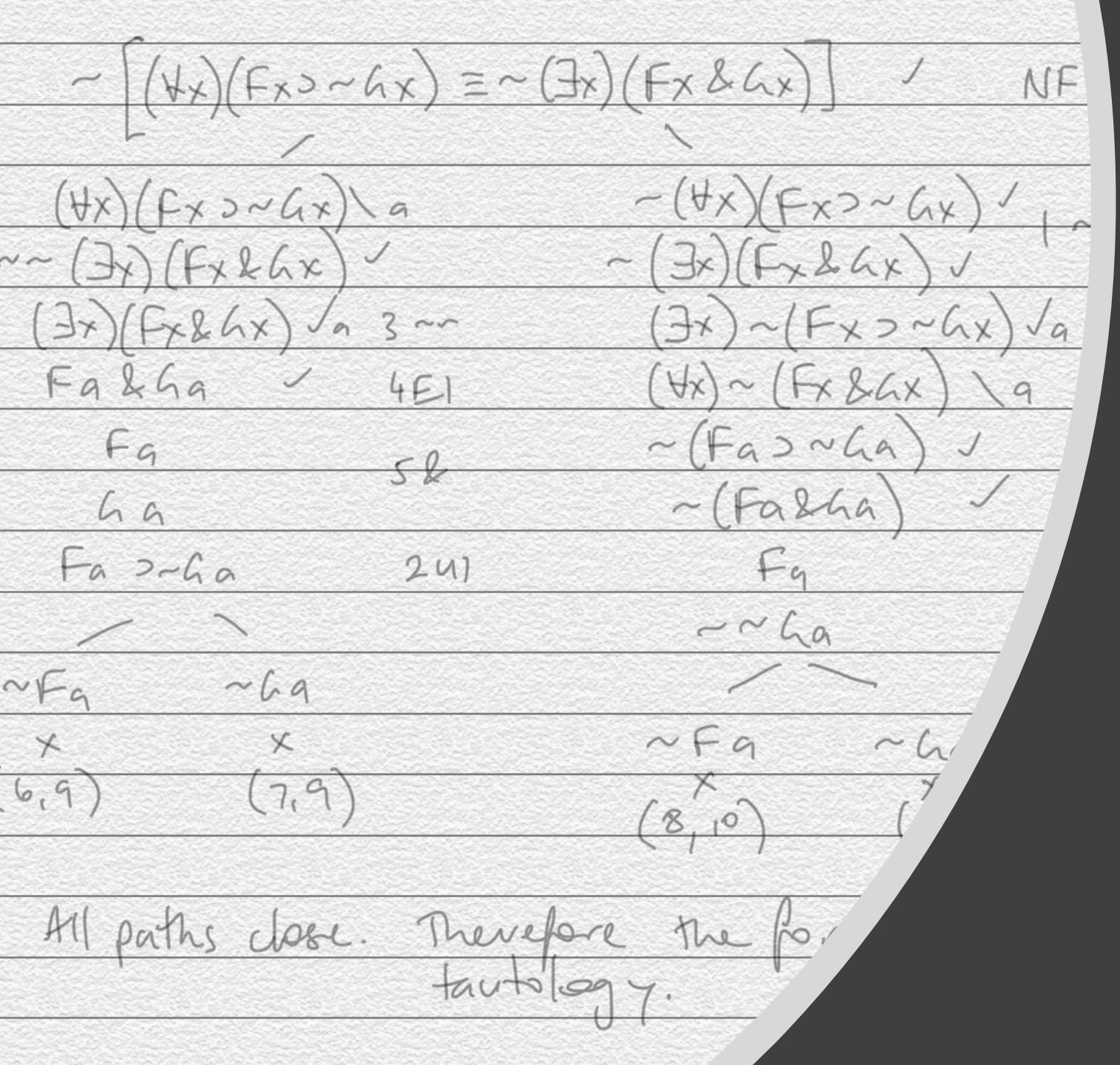


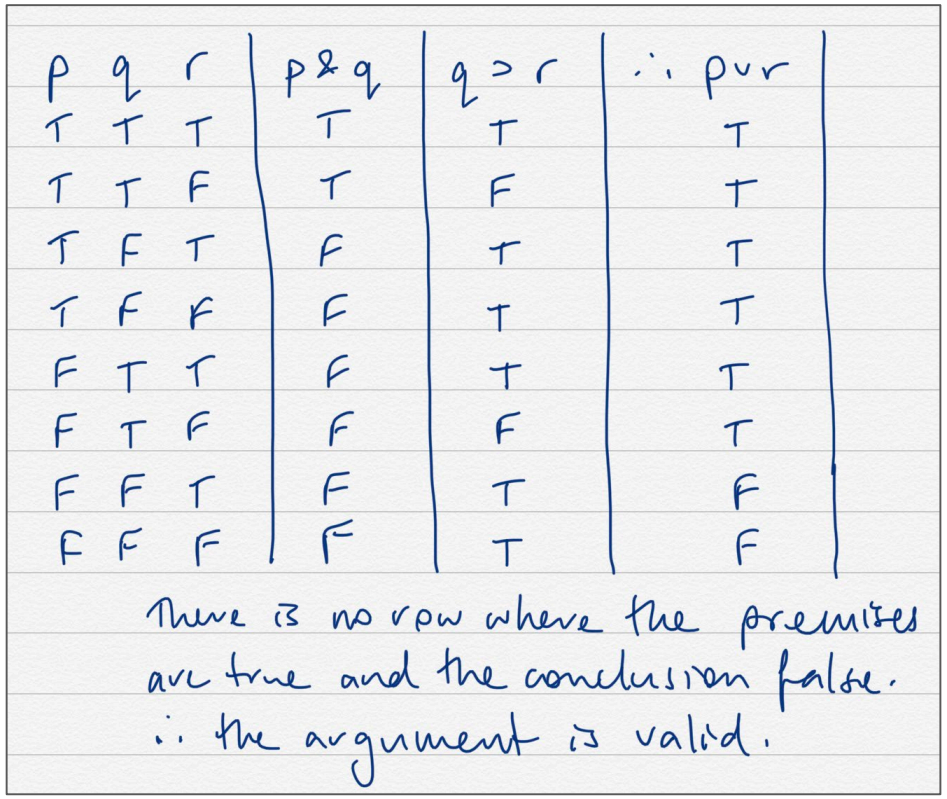
Teaching Logic Online: What do you do when the student needs to draw the answer?

Stephanie Gibbons

University of Waikato

Logic is difficult to put online because we use

- Tables
- Special symbols
- Truth trees (semantic tableaux)



p	q	r	p & q	q ⊃ r	∴ p ∨ r
T	T	T	T	T	T
T	T	F	T	F	T
T	F	T	F	T	T
T	F	F	F	T	T
F	T	T	F	T	T
F	T	F	F	F	T
F	F	T	F	T	F
F	F	F	F	T	F

There is no row where the premises are true and the conclusion false.
∴ the argument is valid.

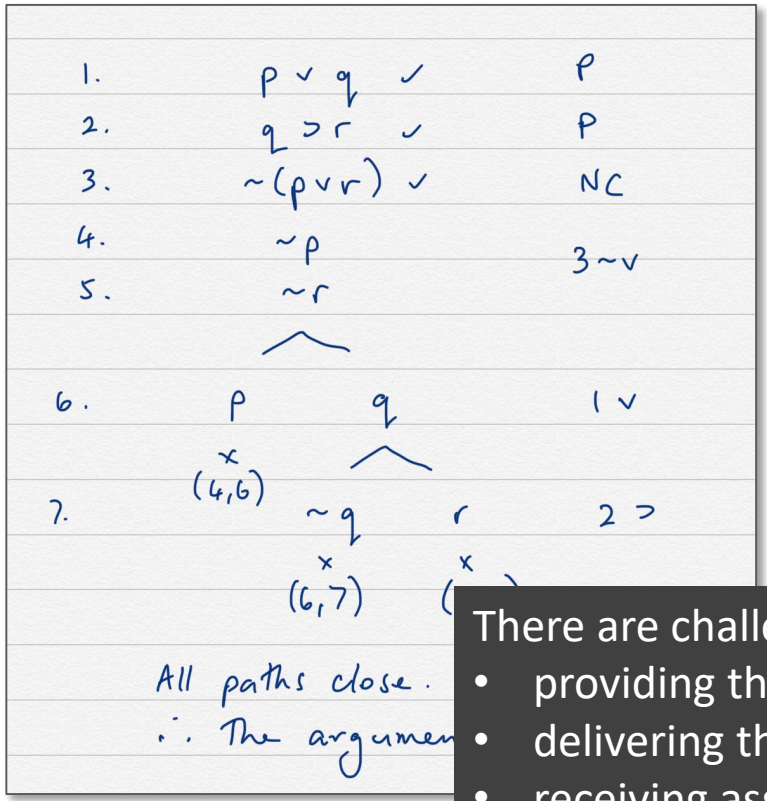
$$(\forall x)(Fx \supset \sim Gx) \equiv (\exists z)(\forall y)(Rzy \vee Hz)$$

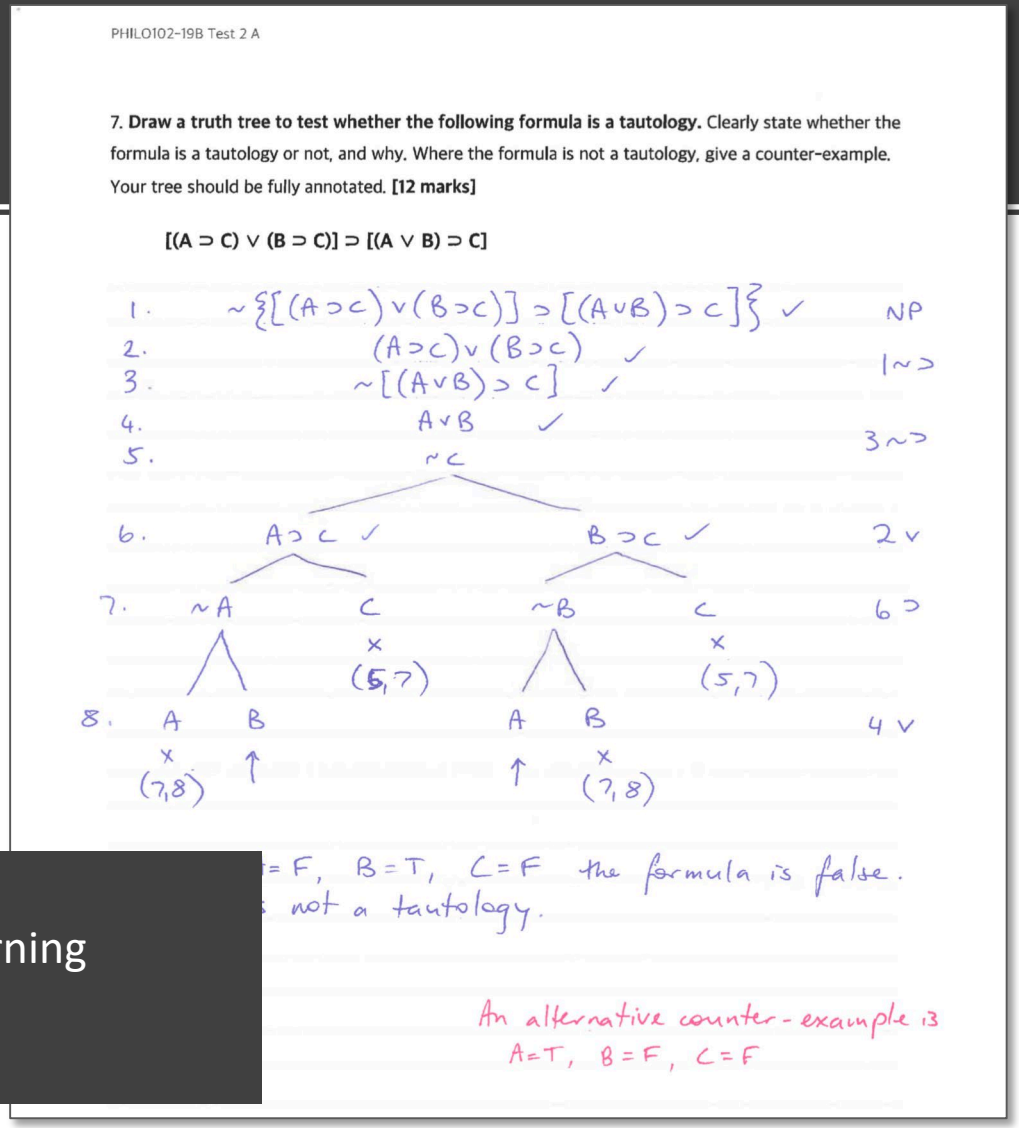
Both of these can be typed relatively easily.

The real problem is trees…

It might be possible to type some trees…

- But some would be really difficult





There are challenges for

- providing the feedback needed for learning
- delivering the instruction
- receiving assessment

Requirements

- If possible, everything should be done through Moodle
- No special software!
- No special equipment
- Everything needs to be accessible for those who are not tech-savvy.

- Students need to show they can solve problems themselves.
- I need to know it is their own work.

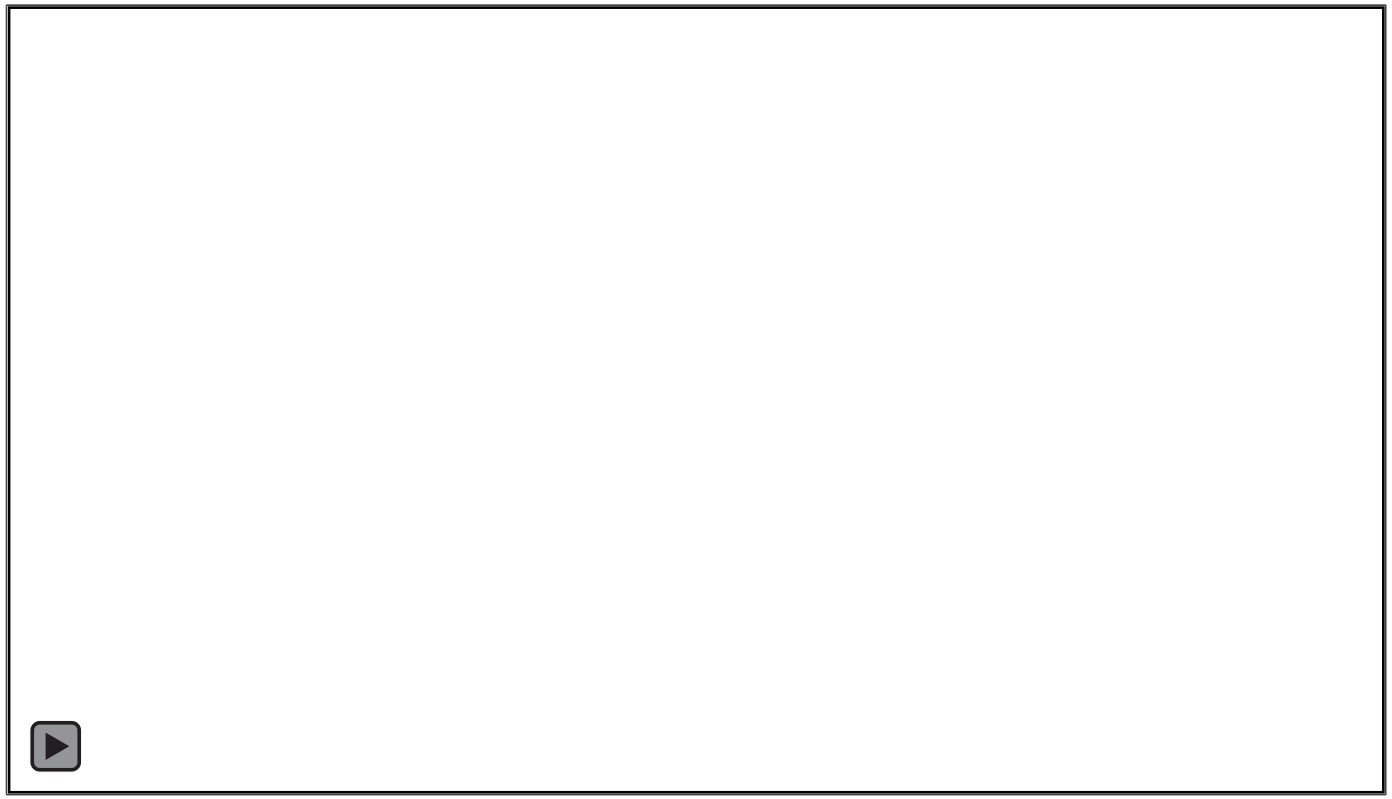
What needed to be adapted?

- Skills building quizzes
- Lectures
- Tutorials
- Tests

These already existed

What needed to be adapted?

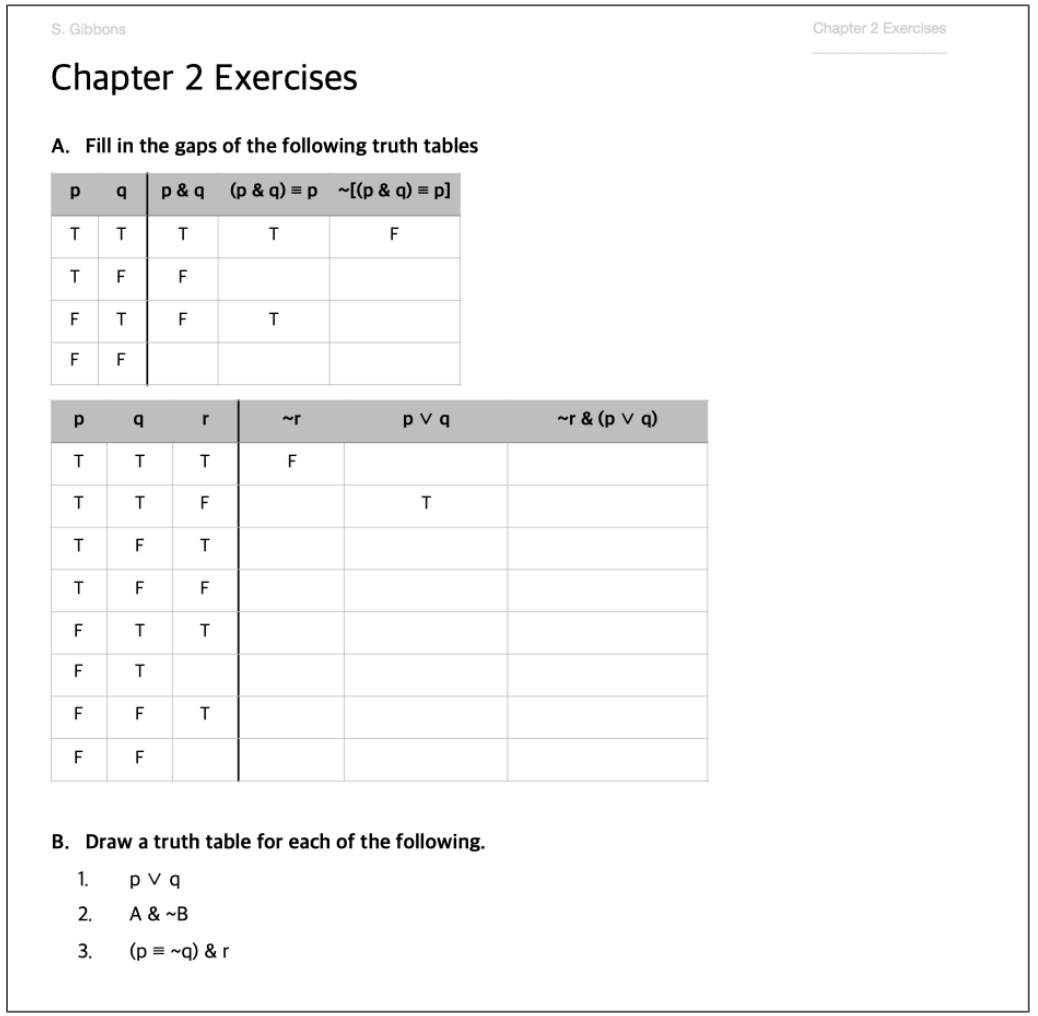
- Skills building quizzes
- **Lectures**
- Tutorials
- Tests



Each lecture was replaced with a lesson with embedded videos, and questions about the material.

What needed to be adapted?

- Skills building quizzes
- Lectures
- **Tutorials**
- Tests



S. Gibbons

Chapter 2 Exercises

Chapter 2 Exercises

A. Fill in the gaps of the following truth tables

p	q	p & q	(p & q) ≡ p	~[(p & q) ≡ p]
T	T	T	T	F
T	F	F		
F	T	F	T	
F	F			

p	q	r	~r	p ∨ q	~r & (p ∨ q)
T	T	T	F		
T	T	F		T	
T	F	T			
T	F	F			
F	T	T			
F	T				
F	F	T			
F	F				

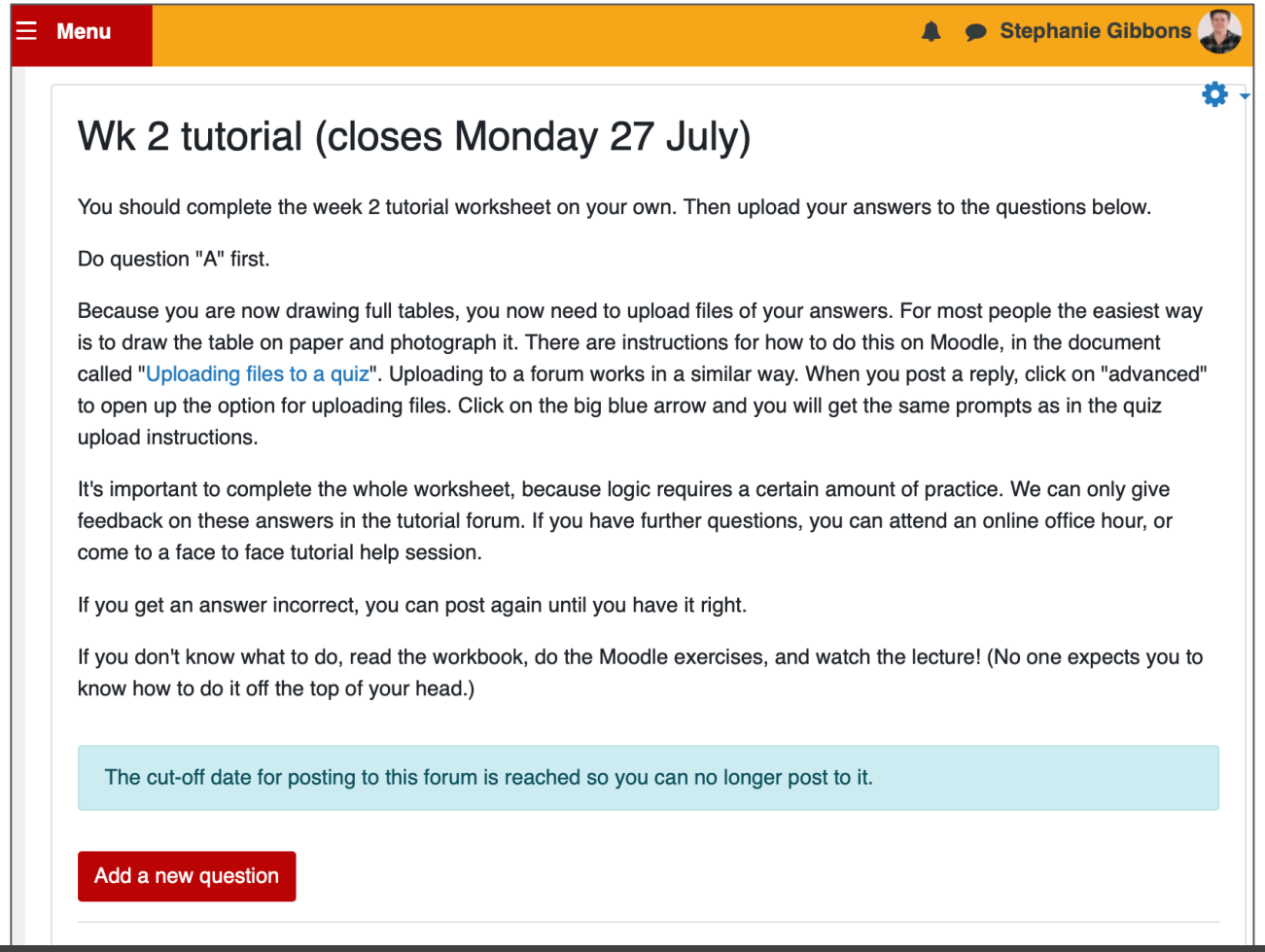
B. Draw a truth table for each of the following.

1. p ∨ q
2. A & ~B
3. (p ≡ ~q) & r

Online students did the same worksheets, and uploaded selected answers to a forum

What needed to be adapted?

- Skills building quizzes
- Lectures
- **Tutorials**
- Tests

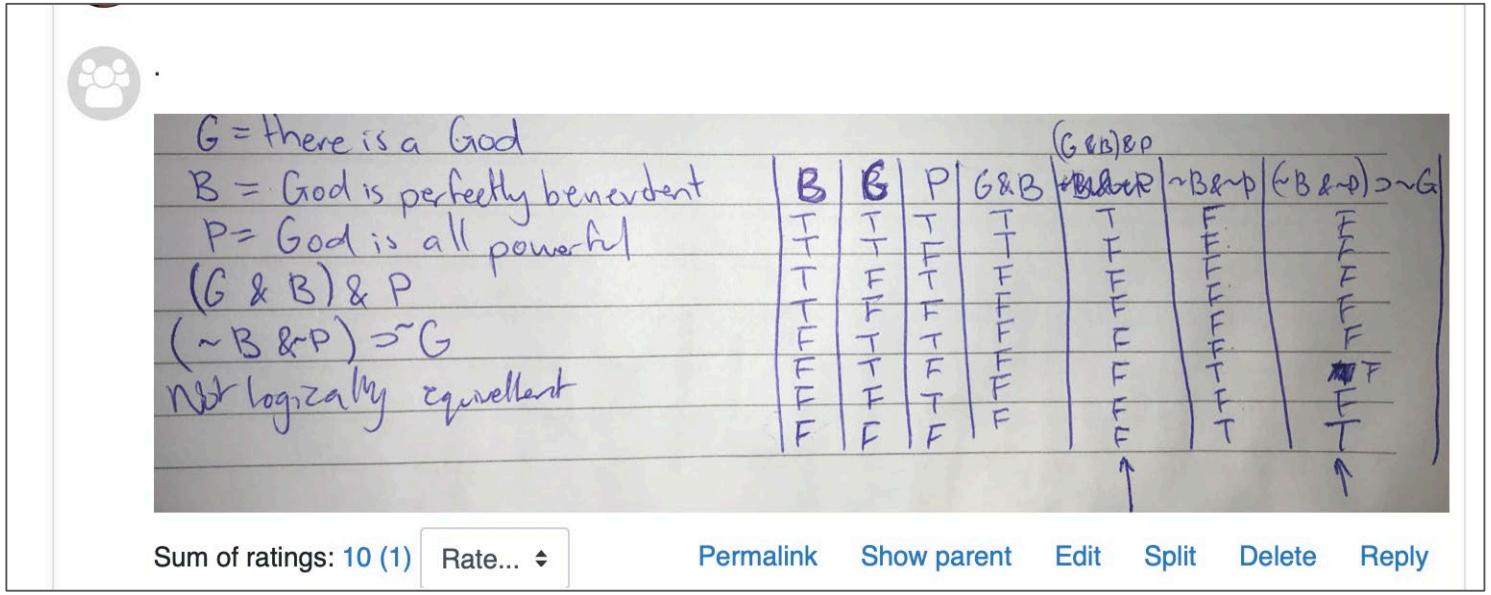


- Forums used the Q and A setting: students cannot see other people's posts until they post
- Forums were graded, but students could keep posting until they gave the correct answer.

What needed to be adapted?

- Skills building quizzes
- Lectures
- **Tutorials**
- Tests

Some answers can be typed
But usually students drew them on paper, photographed them with their phone, and uploaded the photograph



What needed to be adapted?

- Skills building quizzes
- Lectures
- Tutorials
- **Tests**

Tests offer the biggest challenge

- The 3 tests are the main assessment (20%; 25%, 25%)
- Some questions can be asked using multichoice, but the student also needs to be able to solve whole problems

- For a test, it needs to be easy and fast
- It needs to be accessible (no special equipment or software)
- I need to know it is the student's work
  - Online tests make it possible for students to share questions and answers
  - As it's online, the test needs to be open book
- I wanted a time limit
- But also a time window…

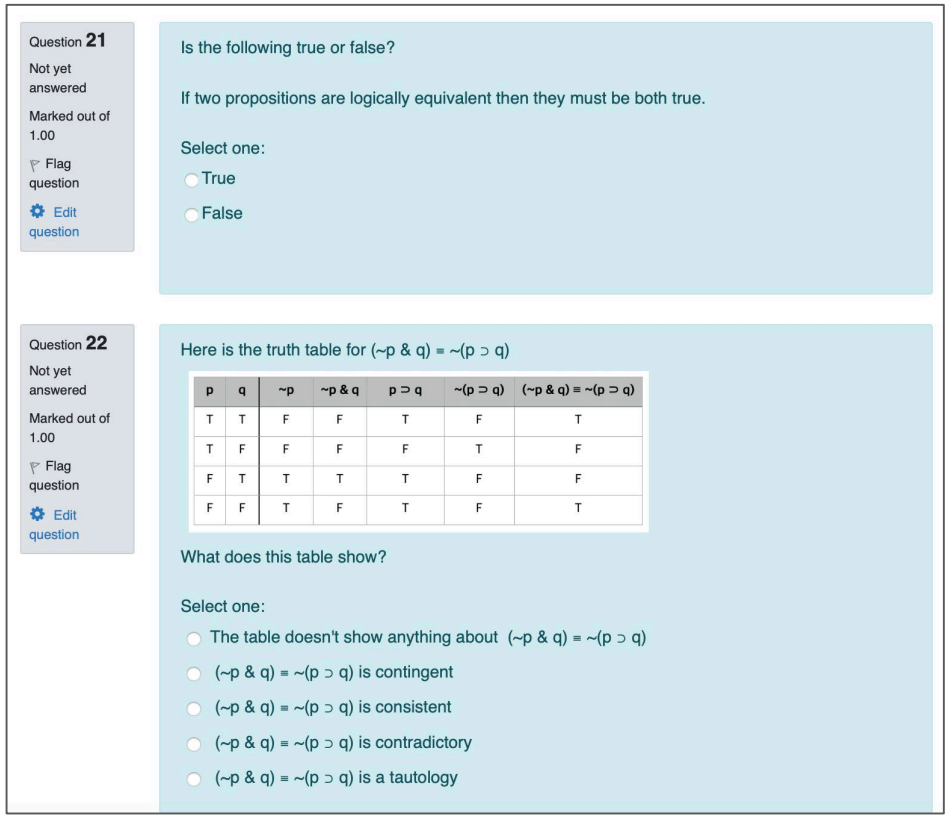
What needed to be adapted?

- Skills building quizzes
- Lectures
- Tutorials
- **Tests**

I divided each test into two parts.
Both parts were completed using the Moodle quiz activity

Part A was multichoice questions:

- Each question was randomly selected from a category containing 5-12 questions
- Students answer 25 or so questions in 30 minutes



Question 21

Not yet answered

Marked out of 1.00

Flag question

Edit question

Is the following true or false?

If two propositions are logically equivalent then they must be both true.

Select one:

- True
- False

Question 22

Not yet answered

Marked out of 1.00

Flag question

Edit question

Here is the truth table for (~p & q) ≡ ~(p ⊃ q)

p	q	~p	~p & q	p ⊃ q	~(p ⊃ q)	(~p & q) ≡ ~(p ⊃ q)
T	T	F	F	T	F	T
T	F	F	F	F	T	F
F	T	T	T	T	F	F
F	F	T	F	T	F	T

What does this table show?

Select one:

- The table doesn't show anything about (~p & q) ≡ ~(p ⊃ q)
- (~p & q) ≡ ~(p ⊃ q) is contingent
- (~p & q) ≡ ~(p ⊃ q) is consistent
- (~p & q) ≡ ~(p ⊃ q) is contradictory
- (~p & q) ≡ ~(p ⊃ q) is a tautology

What needed to be adapted?

- Skills building quizzes
- Lectures
- Tutorials
- **Tests**

Part B used the ‘essay question’ in the Moodle quiz:

- This allows students to upload a file for their answer

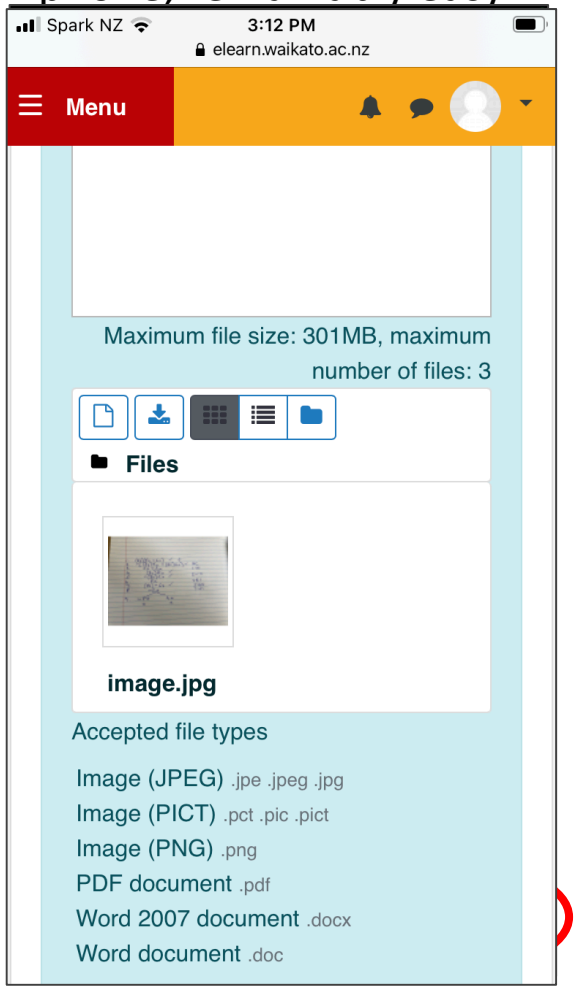
- Using the Moodle quiz allows me to set a time limit and a time window
- Questions are randomly selected from categories, so students don’t all get the same questions. That makes it harder to share questions and answers.
- The only equipment needed is a smartphone (and pen and paper)

What needed to be adapted?

- Skills building quizzes
- Lectures
- Tutorials
- Tests

How hard is it for students to use?

If they do the quiz on their phone, remarkably easy.
Here's what they see:



Write the answer on paper

This opens the camera

What needed to be adapted?

- Skills building quizzes
- Lectures
- Tutorials
- Tests

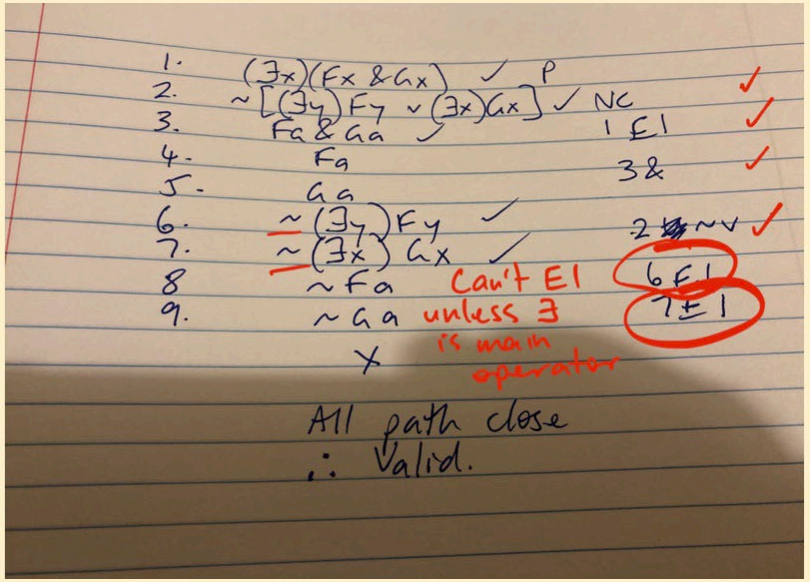
How hard is it to mark?

It's fiddlier than marking on paper – you have to open the photo, draw on it, then upload the marked image back to the test.

But I got faster at it.

image.jpg

Comment:



or override mark

But how do you stop them cheating?

What needed to be adapted?

- Skills building quizzes
- Lectures
- Tutorials
- **Tests**

How do you stop them cheating?

Students are permitted to use any course materials during the test. So looking up instructions doesn't count as cheating.

The value of sharing questions and answers is diminished by students getting different questions

Websites that solve problems pose a greater challenge.

- Students are required to set up their answers in specific ways, and lose marks for not doing so
- All students were required to do an oral component for Part B of their test

Pitfalls

- For the students
- For me

- Students took longer on Part B of their tests than I expected.
- Although they had opportunity to practice uploading files before the test, not all took it.
- Things can go wrong: internet, technology, life…
- I received fewer partial answers than I would in a paper test.

- I could no longer reuse tutorial questions or problems I had demonstrated in class in the test.
- It’s harder to ask really difficult questions, because it’s challenging to come up with alternatives that are equally difficult.

On the whole it went very smoothly

What about students who don’t have a smartphone?