

# Using student feedback to design a more effective Clinical Biochemistry course component

UNIVERSITY OF  
**WATERLOO**

[uwaterloo.ca](http://uwaterloo.ca)

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Situated in downtown Kitchener, 7  
km from rest of UW campus

First graduating class 2011  
~ 115 students/year

# Integrated Patient Focused Care 1-9

- Students begin IPFC courses starting in their second year
- IPFC 1 - fundamental content
- IPFC 2 to 9 – integrate concepts of therapeutics, pharmacology, pathophysiology, medicinal chemistry, pharmacokinetics and toxicology into a systems-based format

**Course - IPFC1**  
Integrated Patient Focused Care 1

**Section - Foundational Material**

**Component – Immunology**  
(Lecture)

**Component - Critical Appraisal**  
(Lecture)

**Component - Patient-focused Care**  
(Lecture)

**Component – Clinical Biochemistry**  
(2010: Lecture)  
(2011: Online modules +  
Face-to-face tutorial)

**Section – Pharmacokinetics**  
(Online modules +  
Face-to-face tutorial)

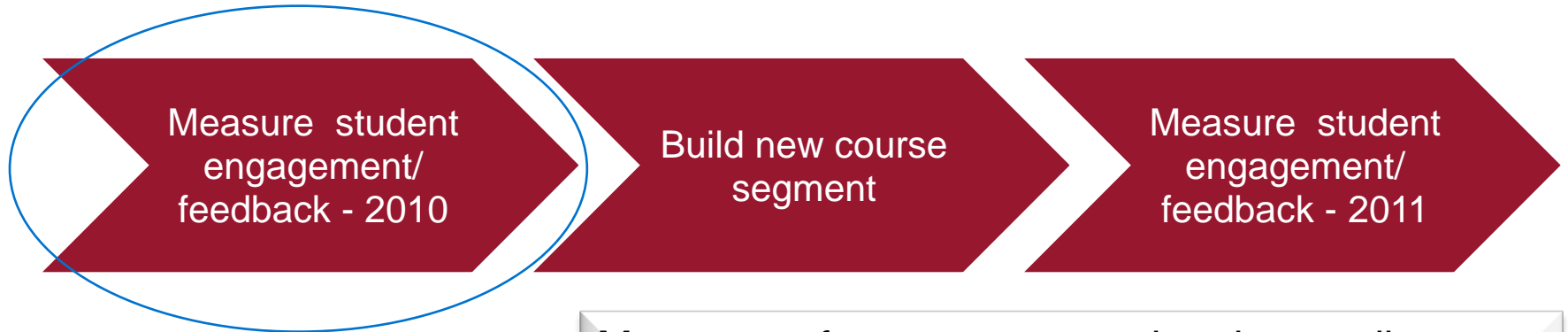
# Objectives

- Create a blended Clinical Biochemistry module based on student feedback
- Assess if the introduction of multi-media based teaching module using virtual field trips, self-assessments and face-to-face tutorial
  1. increases student understanding of the connections between the results from lab measurements and patient assessment
  2. enhances student engagement

# Why Blend?

- I felt comfortable with using technology to build materials
- I liked the idea of the reusability of the online modules
- I felt that having a blended format would save me and the instructor (Angela Stark) time as well as allow students to learn difficult material at their own pace
- Had success with blended format in another section of the course (pharmacokinetics)

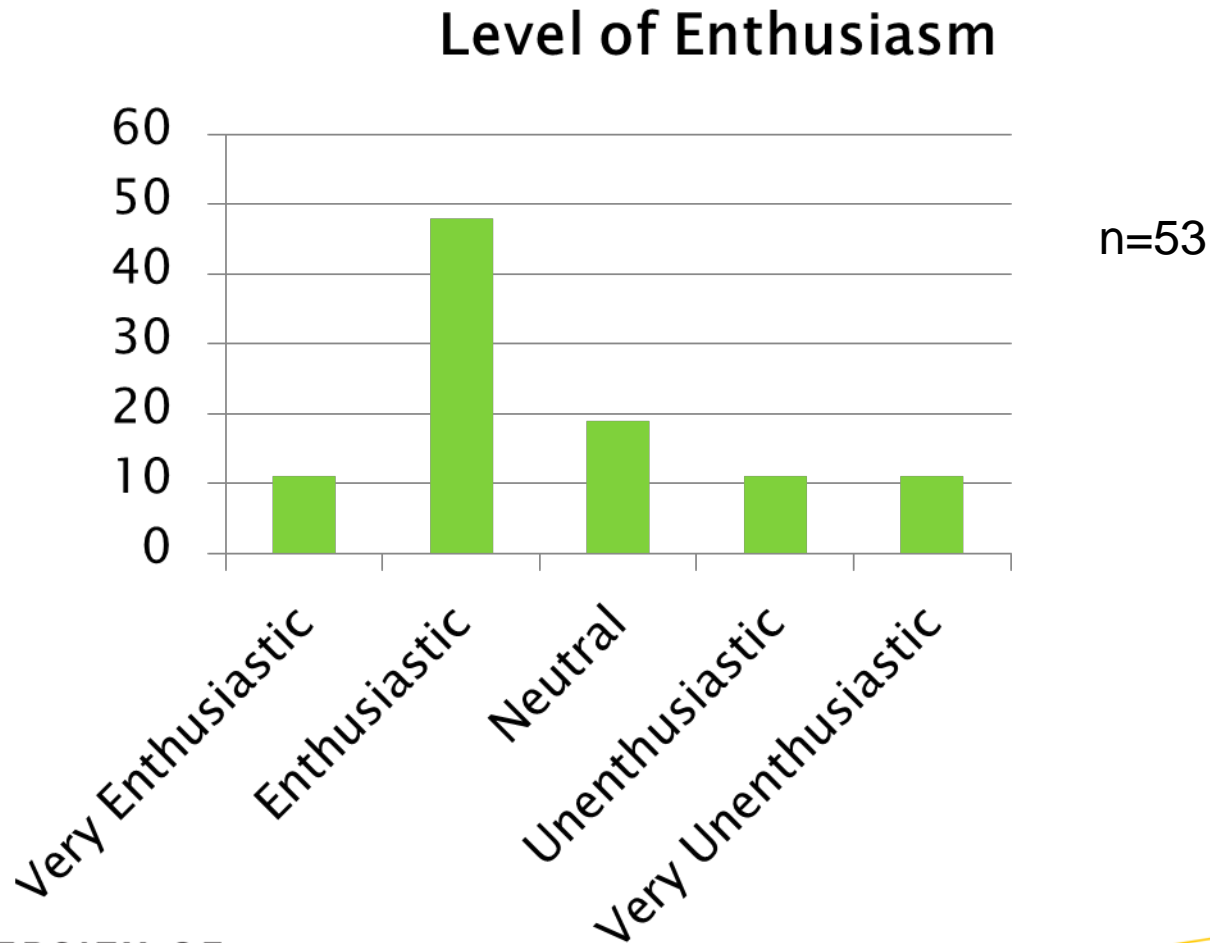
# Based on the premise that blending was a good way to go in Clinical Biochemistry ....



## Measures of engagement and understanding:

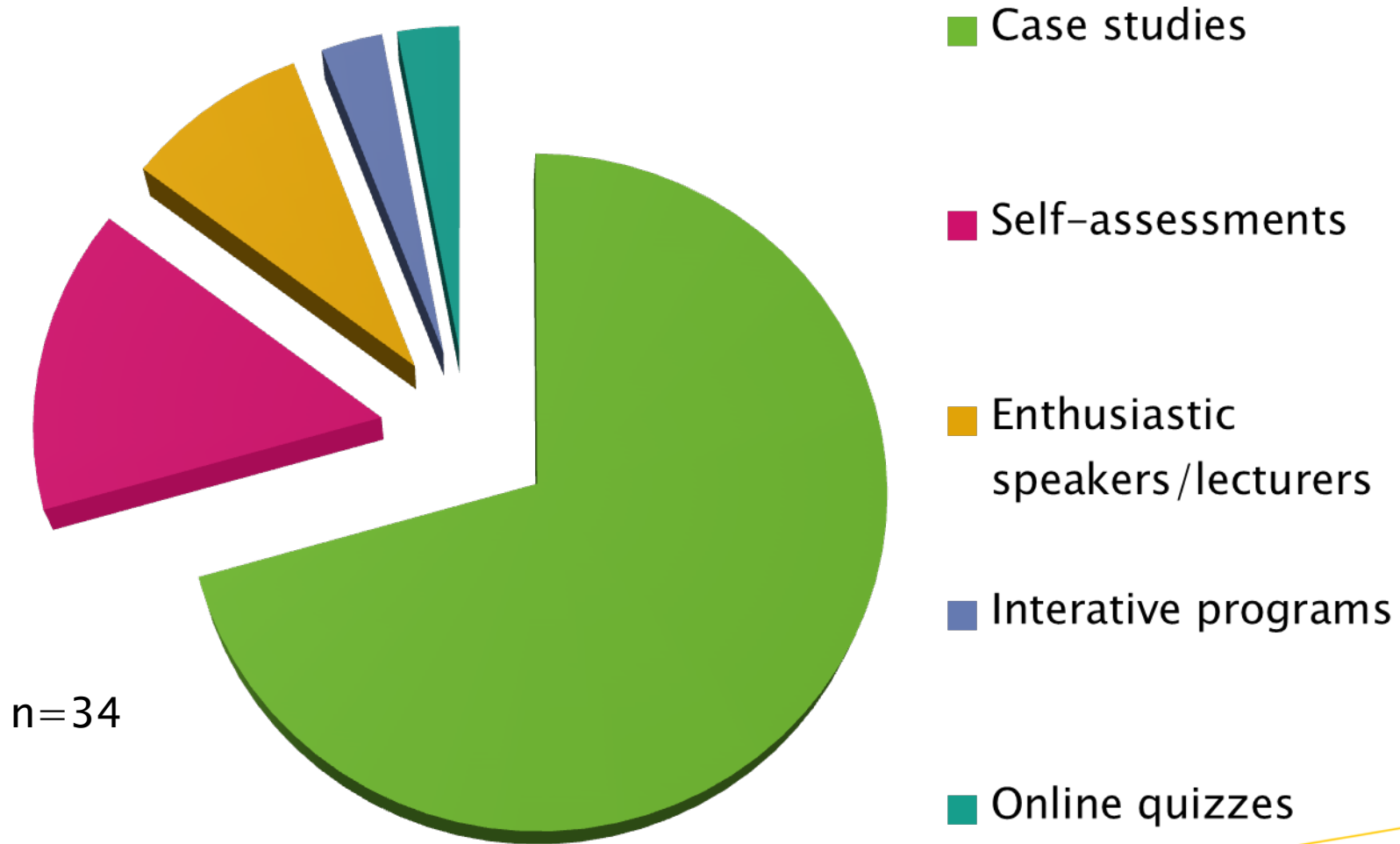
- Feedback from 2010 cohort on what would help them engage and make connections
- Comparison of common exam questions in 2010 and 2011 to examine connections between the results from lab measurements and patient assessment

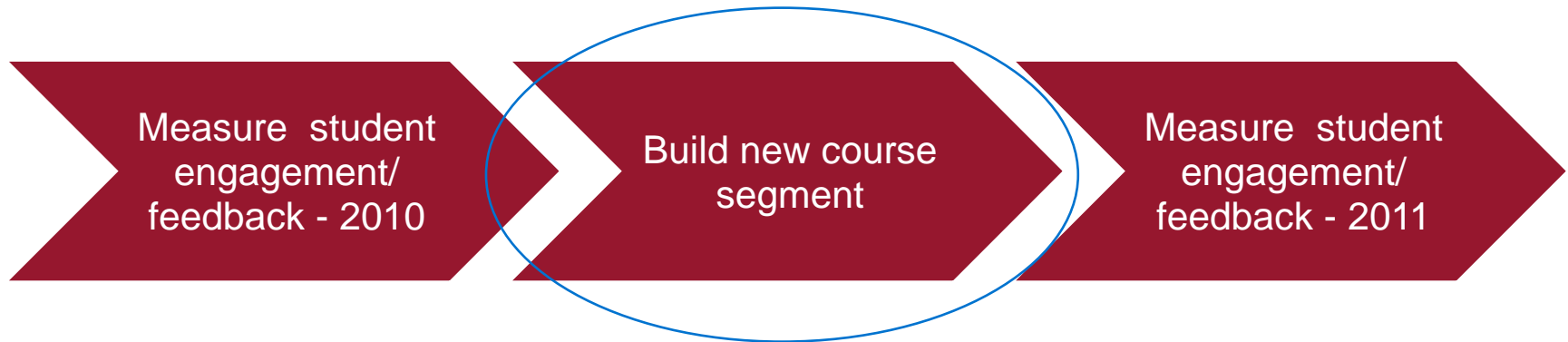
What is your LEVEL OF ENTHUSIASM for introducing a blended format to the Clinical Biochemistry section of the course?





# Student Feedback - What *online* course activities would help you connect lab results with patient assessment ?





- Built around:
  1. incorporating one major case (little Billy) and several smaller cases
  2. self assessment pieces (mostly quizzes)
  3. a virtual field trip to clinical biochemistry lab (video in the field)

# Development of the storyboard.....

**Basic Skills**  
Interpreting Lab Data

**Learning Outcomes**  
Summarise basic concepts in interpreting lab data, incl. sensitivity, specificity, predictive value, accuracy, precision. Define ref range, identify factors that affect ref range, identify special situations, determine when a test is abnormal, interpret abnormal, explain to a patient why the test is abnormal.

**Accuracy**  
- exactness of measurement  
- close to true value

**Precision (lab control measures)**  
- consistency of results

**Sensitivity**  
- Ability of test to identify @ results  
- for who actually have the disease  
- True positive rate  
- proportion of true positives detected by the test  
- 80% sensitivity @ 95% in every patient who actually has disease  
- highly sensitive test preferred when consequences of not identifying disease are serious  
- In lab, range which easy measurability  
- highly sensitive test helps the doctor to rule out  
- SNout - A highly Sx Negative test  
- Negative result is good for ruling out

**Specificity**  
- Ability of test to identify @ results - for who do not have disease  
- True negative rate  
- proportion of true negatives detected by the test  
- 95% specificity @ 95% in every patient who does not have disease  
- highly specific test preferred when consequences of not identifying disease are serious  
- In lab, range of error of test is not a problem  
- SNin - A highly Sx Positive test  
- Positive result is good for ruling in

**Sensitivity & Specificity**

**Calculating Sensitivity & Specificity**

Test Result	Actual Disease	Not Actual Disease
Positive	True Positive (TP)	False Positive (FP)
Negative	False Negative (FN)	True Negative (TN)

**Prediction Value**  
- Consider specificity, sensitivity, & predictive value's reliability  
- positive test's reliability  
- false positive risk is related to the test's specificity  
- false negative risk is related to the test's sensitivity

**Quantitative Tests**  
- read numerical measurement  
- change -> test  
- change -> test

**Qualitative Tests**  
- Pos or Neg (Qualitative)  
- accuracy test  
- Sensitivity  
- Pos or Neg (Qualitative)  
- accuracy test  
- Sensitivity  
- Pos or Neg (Qualitative)  
- accuracy test  
- Sensitivity

**Test Results**  
- Ref Range - Conventional  
- Distribution - Normal  
- Mean - 100  
- SD - 15  
- Units - g/L  
- Con (at least)

**Question Normal Distribution**

**Patient Factors**  
- Age  
- Sex  
- Ethnicity  
- Medication  
- Diet  
- Alcohol  
- Smoking  
- Exercise  
- Stress  
- Illness  
- Pregnancy  
- Menstruation  
- Time of day  
- Time of year  
- Time of test  
- Time of day  
- Time of year  
- Time of test

**How abnormal is the value?**  
- Is the value consistent with the clinical picture?  
- Is the value consistent with the process of pathogenesis in this patient?  
- Is the value consistent with the process of pathogenesis in this patient?  
- Does the abnormality require management?

# Development of the outline...

## 1. Electrolyte Tests

1. *Learning Outcomes & Why check electrolytes?* (read)
2. *Case Introduction – Billy* (read)
3. *Volume assessment*
  1. *Link out to Skin Tenting Photo* (we can reproduce this with acknowledgement)
  2. *Link out to JVP and Hepatojugular reflux* (video) (Andrea to get permission)
  3. *Link out to edema picture* (Andrea to get permission)
4. *Fluid status assessment* (read)
5. *Virtual Lab Tour re: how electrolytes are tested in the lab* (video) (Andrea)
6. *Billy's lab result table with numerous link outs*
  1. *Sodium – narrated PowerPoint* (Angela)
  2. *Potassium - narrated PowerPoint* (Angela)
  3. *Chloride – read only*
  4. *C02/HC03 – Serum bicarbonate read followed by link out to Acid-base status which is read, followed by Billy's results*
    1. *Self-assessment question on Billy's values*
    2. *Magnesium, Calcium and Phosphate – narrated PowerPoint* (Angela)
7. *Framework to interpret lab values* (read)
  1. *link out to the narrated PowerPoint on this from the Basic skills module*
8. *Self-assessment questions – must complete before moving on*

# Development of the modules...

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This IPFC1 course module presents some of the fundamentals of Clinical Biochemistry and how laboratory test interpretation relates to patient assessment. Presentation of this material is in a multi-media format and it is expected that you complete this section on-line. Upon the completion of the online component, an in-class case-based discussion will help to solidify your understanding of how electrolyte testing and renal and hepatic function tests are used in patient assessment, and in some cases, drug dosing.

## **Module One: Basic Skills in Interpreting Laboratory Data**

This course section focuses on the description of different kinds of laboratory tests as well as provides a general framework for the interpretation and management of abnormal laboratory values.

 [Module One Presentation | PDF \(6.5MB\)](#)



## **Module Two: Electrolyte Tests**



## Face-to-face tutorial ...

- Two cases presented and students could prepare for either. Working first with the group and then the instructor to analyze each of the cases.

*SouthCentral  
Medical*



Patient ID:	Encounter:	Date:
#58417	EMERGENCY ROOM	JAN 5

Patient Name:	Age:	Sex:	Admitting Diagnosis:
PETER PRINCE	44 Y	M	EDEMA, FATIGUE

RESULTS LIST			
Result Name:	Results:	Units:	Reference Range:
Sodium (Na)	135	mmol/L	135-145
Potassium (K)	3.4	mmol/L	3.5-5
Chloride (Cl)	98	mmol/L	100-108
Bicarbonate (HCO <sub>3</sub> )	22	mmol/L	24-30 (CO <sub>2</sub> )
BUN	16.2	mmol/L	2.5-8
SCr	253	μmol/L	58-110
Calcium (Ca)	1.91	mmol/L	2.1-2.6
Albumin	29	g/L	35-50



- Common questions on exam in 2010 and 2011 were used to compare the ability of students to make connections between the results from lab measurements and patient assessment
- Measured changes in perceived gains on two course objectives
- Shifts in the survey questions that measure engagement
- Feedback on modules to tweak new course design

# 2010 and 2011 Comparison of Assessed Success

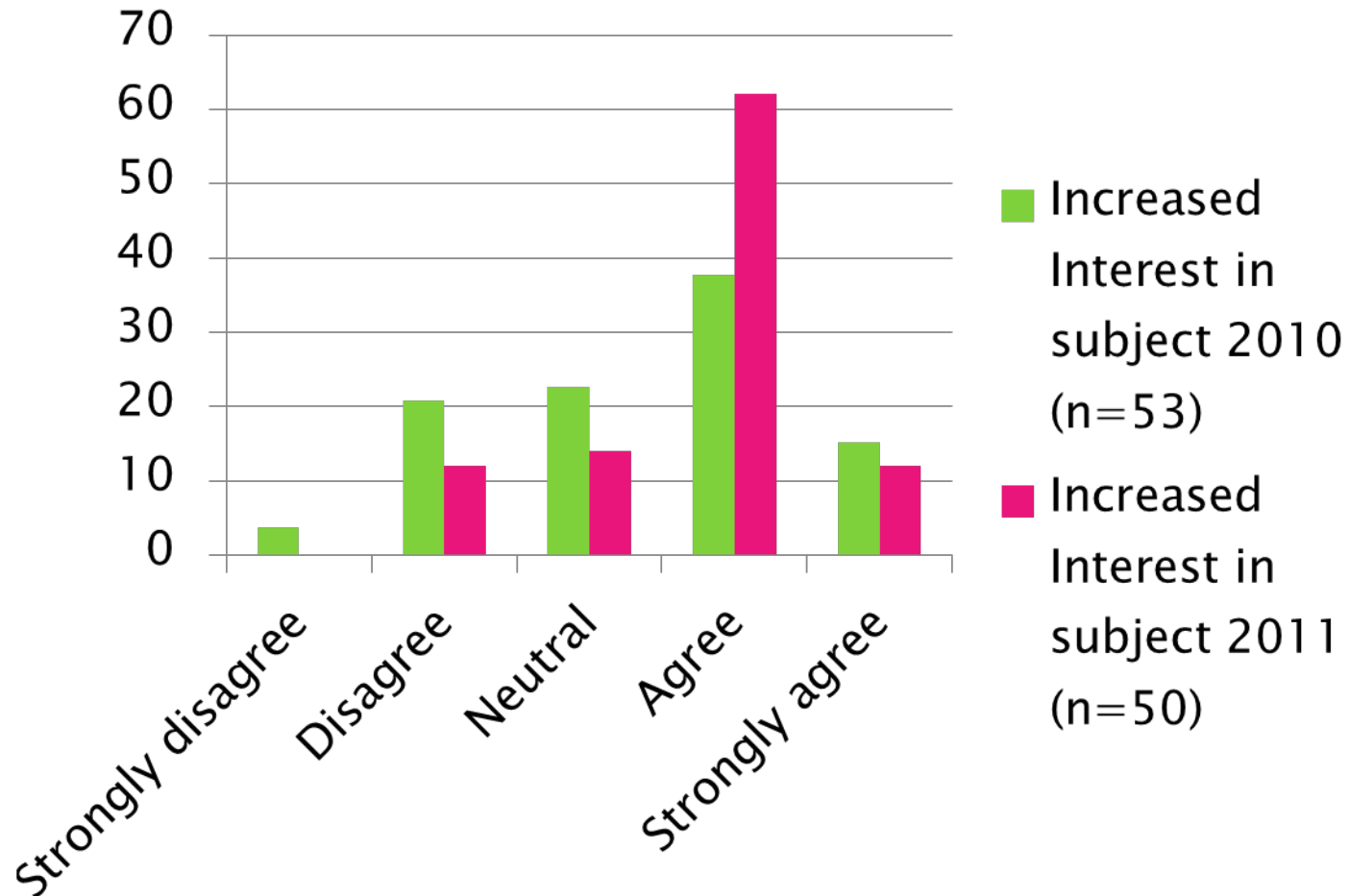
- Exam scores in the Clinical Biochemistry part :
  - 61.8%  $\pm$  17.8 (n=109) in 2010
  - 78.8%  $\pm$  11.7 (n=116) in 2011 (t = -8.46, p < 0.0001)
- Exam scores in the 'Pharmacokinetics' midterm:
  - 80.5%  $\pm$  7.8 (n=108) in 2010
  - 83.6%  $\pm$  7.3 (n=116) in 2011 (t = -3.03, p = .003)



# 2010 and 2011 Comparison of Course Value

- We asked 2 course value and 3 engagement questions in the 2010 and 2011 questionnaires'
- “This course will be important in my future” - no change
- “This component of IPFC1 increased my interest in the subject” - significant increase in course interest following the redesign

“This component of IPFC1 increased my interest in the subject”



# 2010 and 2011 Comparison of Course Engagement

- Non-significant increase in mean rank for the 3 engagement questions

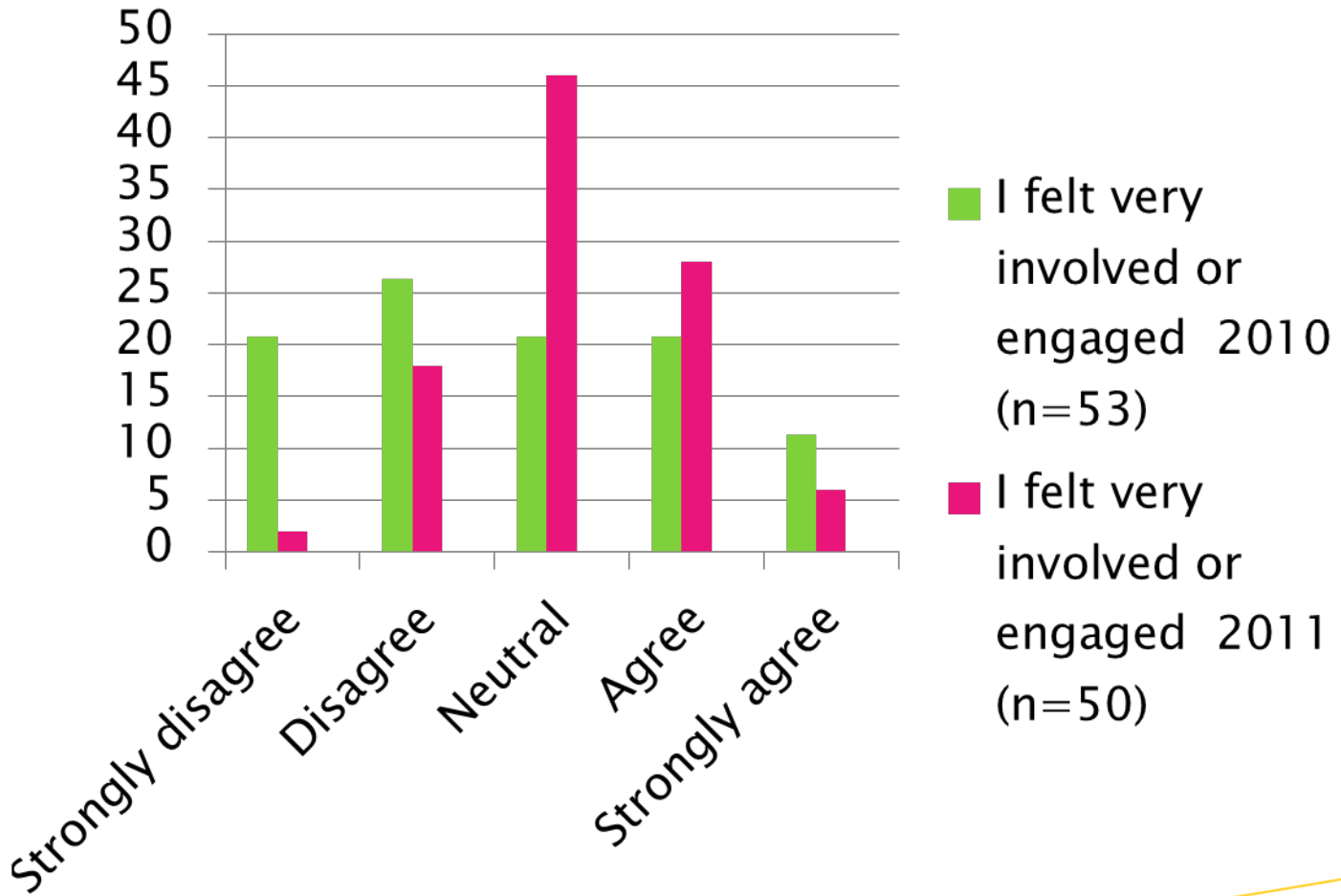
State your level of agreement with:

“Students shared their ideas/knowledge in this component of IPFC1”

“This component of IPFC1 encourages questions and ideas”

“I felt very involved or engaged in this component of IPFC1”

# “I felt very involved or engaged in this component of IPFC1”



# 2010 and 2011 Perceived Learning Gains

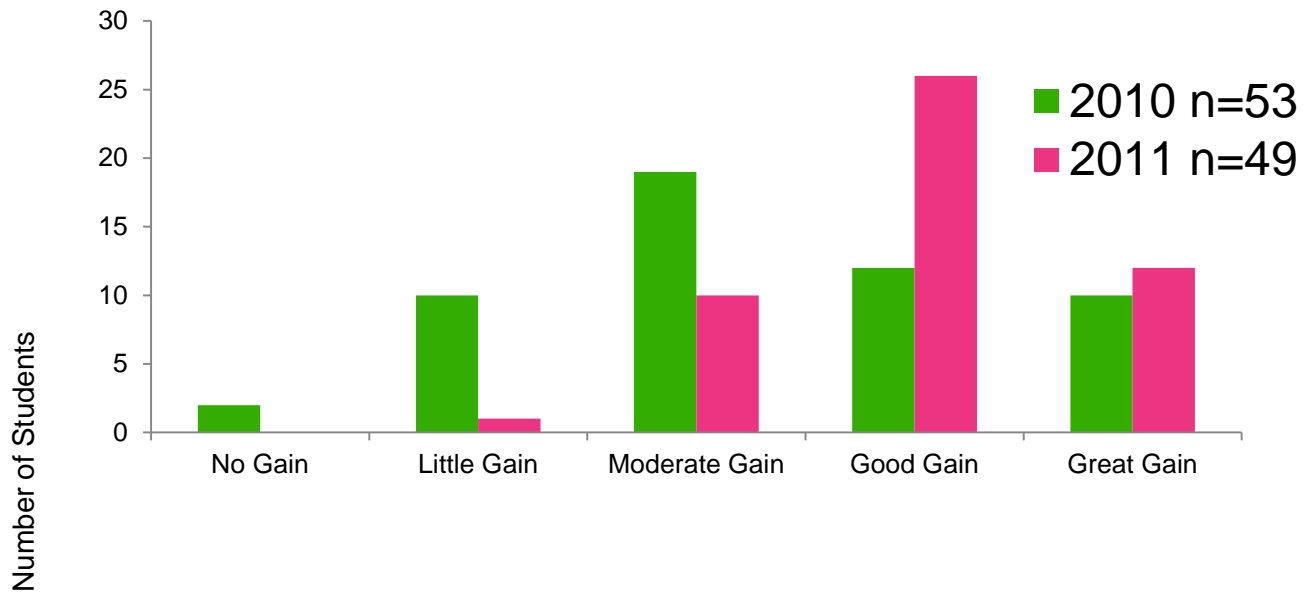
- Significant increase in mean rank for the 2 perceived learning gains questions

As a result of your work in this class what gains did you make in your understanding of

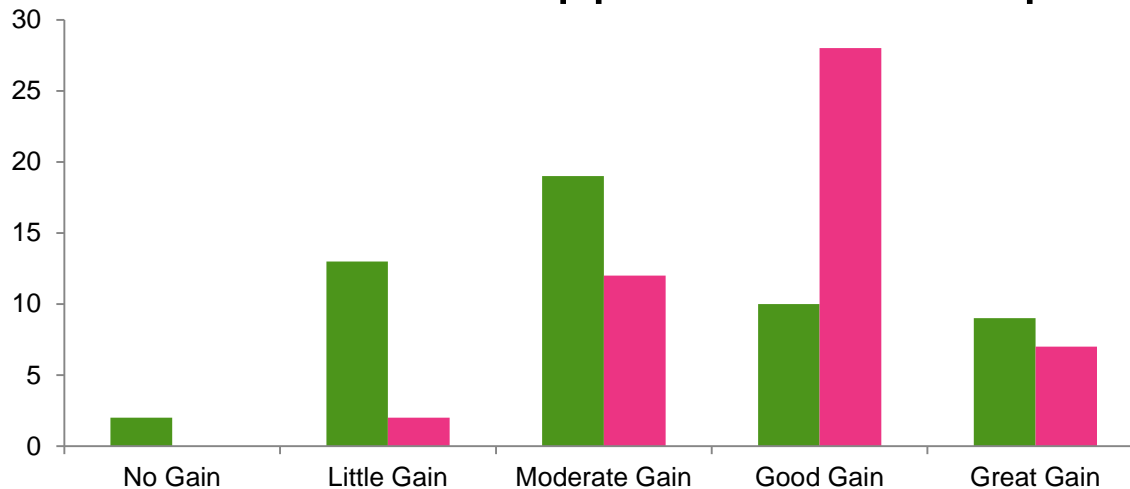
“The role of lab results in patient assessment”

“The development of a rational approach for interpreting laboratory data”

# Role of lab results in patient assessment



# Development of a rational approach for interpreting lab data



Most to least effective course components  
for achieving learning outcomes in 2011

**Self-assessment Quizzes**

**Case Studies**

**Face-to-face Tutorial**

**Virtual Field Trip**

**Online Discussion**

# Open-ended questions...

How the **online course activities** helped them achieve learning outcomes...

31

Provided situations for applied knowledge or problem solving  
Allowed learning at individual pace, time flexibility  
Case studies were helpful

6

Having more tutorials would help



# Open-ended questions...

How the **face-to-face tutorial** helped them achieve learning outcomes...

43

Problem solving and cases clarified concepts  
Discussing and talking through cases very helpful  
Engaging with other students/group work valuable exercise

6

Not enough tutorials

# Summary

- Suggestions from the 2010 cohort improved the 2011 design
- The measured outcomes were increased perceived and actual learning gains in 2011
- Gained knowledge on the most effective to least effective online activities
- Students appreciated the flexibility of the blended format to learn at their own pace and to review or repeat as necessary

# Lessons Learned

- For a 6 hour segment of IPFC1, this was ALOT of work
- Based on student feedback, this work was justified