Supplemental Material

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Supplemental Materials

Figure S1. Example AACR Report for an AACR question about information flow. In spring 2016, at the time of data collection for this study, participating faculty received AACR reports via a web link, and they could download a PDF report as well. Immediately below is a screenshot of the first page of the web-based AACR report. Subsequent pages include the downloaded PDF report.

AACR Feedback Report

Cluster Distribution and Description

QUESTION: There is a G to A base change at the position marked with an asterisk. Consequently, a codon normally encoding an amino acid becomes a stop codon. How will this alteration influence DNA translation?

For this question, your students fall into 3 Rubric Levels. Students with similar ideas fall into the same Rubric Level. The 3 Rubric Levels and the percentage of students in each Rubric Level are shown in the pie chart below.

Rubric Level	Description
Rubric Level 1	Completely correct response
Rubric Level 2	Incomplete or irrelevant response
Rubric Level 3	Incorrect response

Show [100 ‡] entries   Search: [   ]

Completely correct response	Probability	Incomplete or irrelevant response	Probability	Incorrect response	Probability
Transcription is being used to change the G to A base, it will not change. Transcription uses the same language, so it will not be affected.	0.97	This will affect transcription because the mRNA that comes out of transcription will not be the same as the original DNA sequence. This means that the mRNA sent out will be different, and perhaps shorter, and then the protein will not be the same when sent to the ribosomes.	0.79	This will affect transcription because the stop codon makes the process end before the end of the base chain.	0.91
Codons also do not influence transcription.	0.97	Influences transcription because it will stop the transcription from happening since its a stop codon.	0.79	This alteration will influence transcription because the strands of DNA will be unwinded and used again in with mRNA.	0.91
The change would be something that transcription would just think is normal so it would go on like it would with everything else. The changes would have the organism different from the others and could possibly make a new something but very closely related to something else.	0.97	This alteration influences the transcription by the process DNA is made.	0.79	it will not affect the process of transcription. The only difference would be that since the G was changed to an A, when it is transcribed into RNA, it will be a U instead of a C because codons aren't relevant yet.	0.89

AACR Feedback Report

Rubric Level Distribution and Examples

QUESTION: There is a G to A base change at the position marked with an asterisk. Consequently, a codon normally encoding an amino acid becomes a stop codon. How will this alteration influence DNA translation?

For this question, your students fall into 3 Rubric Levels. Students with similar ideas fall into the same Rubric Level. The 3 Rubric Levels and the percentage of students in each Rubric Level are shown in the pie chart below.
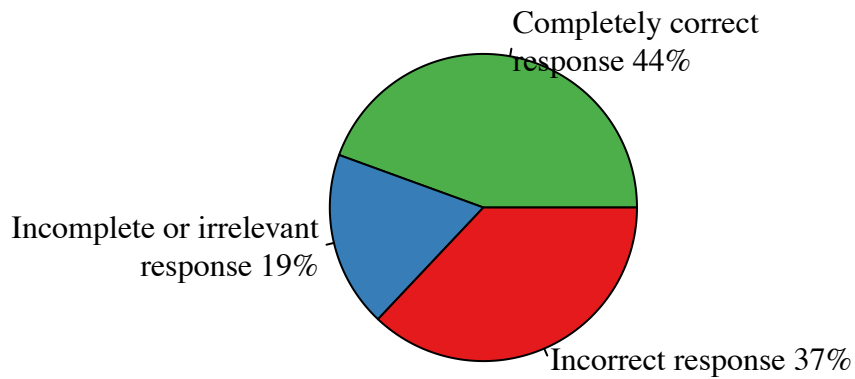
Completely correct
response 44%

Incomplete or irrelevant
response 19%

Incorrect response 37%

Table 1: Rubric Level Descriptions

Rubric Level	Description
Rubric Level 1	Completely correct response
Rubric Level 2	Incomplete or irrelevant response
Rubric Level 3	Incorrect response

Table 2: Example Response of Each Rubric Level

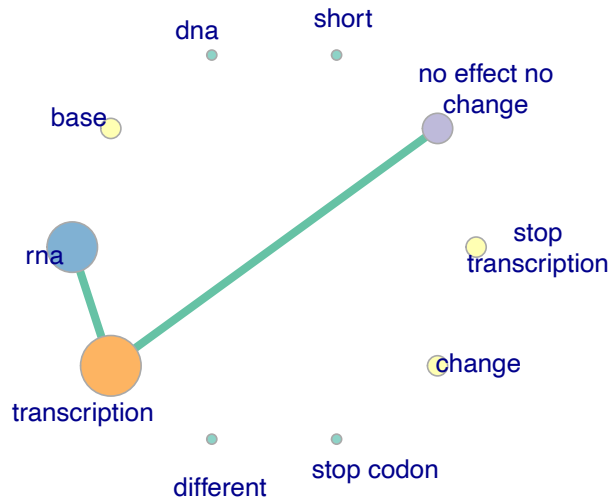| Completely correct response	Incomplete or irrelevant response	Incorrect response
Transcription is being used to change the G to A base, it will not change. Transcription uses the same language, so it will not be affected.	This will affect transcription because the mRNA that comes out of transcription will not be the same as the original DNA sequence. This means that the mRNA sent out will be different, and perhaps shorter, and then the protein will not be the same when sent to the ribosomes.	This will affect transcription because the stop codon makes the process end before the end of the base chain.

Rubric Level Means by Category

Table 3: Mean Occurance of Categories by Rubric Level

Category Means	Completely correct response	Incomplete or irrelevant response	Incorrect response
stop transcription	0.21	0.20	0.40
no effect no change	0.38	0.15	0.22
short	0.17	0.10	0.17
replication	0.02	0.05	0.12
nonfunctional	0.02	0.00	0.02
dna	0.15	0.40	0.38
expression	0.00	0.00	0.00
translation	0.08	0.05	0.02
amino acids	0.02	0.10	0.07
base pair	0.02	0.05	0.02
transcription same as replication	0.00	0.00	0.00
base	0.21	0.15	0.40
polymerase	0.06	0.05	0.10
strand	0.08	0.10	0.07
rna	0.50	0.40	0.52
normal	0.04	0.05	0.00
code	0.02	0.05	0.00
transcription	0.67	0.45	0.62
codon	0.00	0.00	0.00
mutation	0.06	0.15	0.10
wrong	0.06	0.00	0.02
different	0.17	0.05	0.12
stop codon	0.12	0.20	0.22
protein	0.02	0.20	0.02
gene	0.08	0.05	0.07
change	0.21	0.20	0.28
template	0.00	0.00	0.00

Web Diagrams

Completely correct response

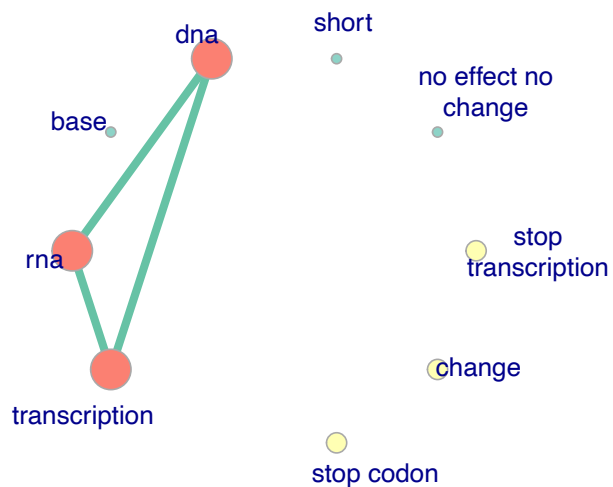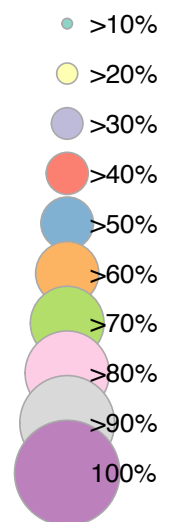## Incomplete or irrelevant response
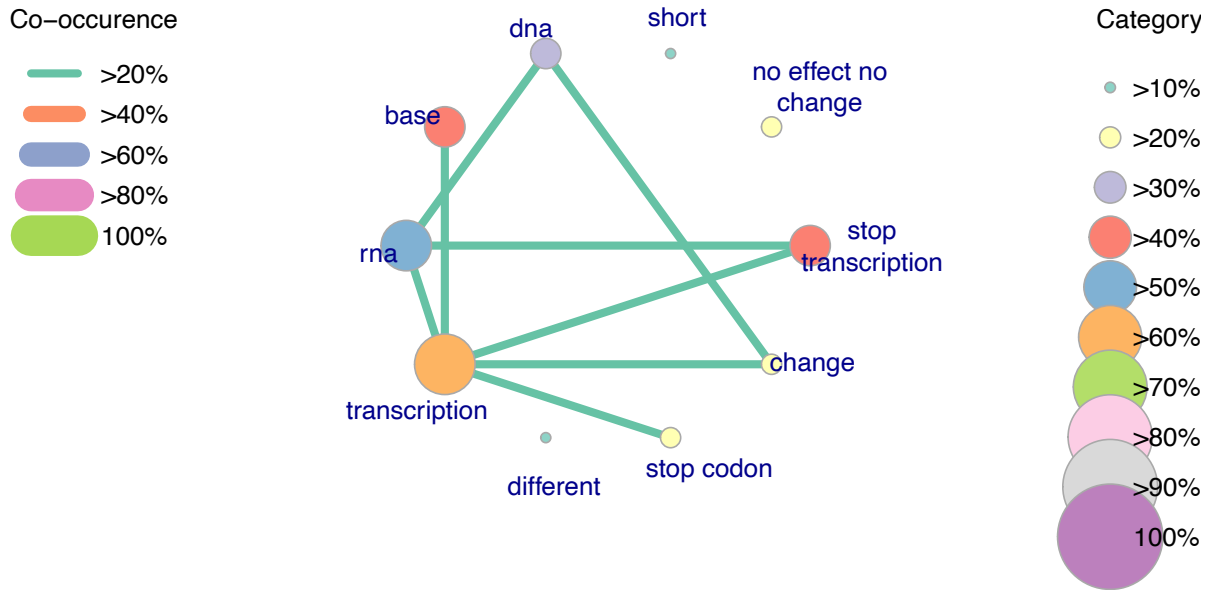

4
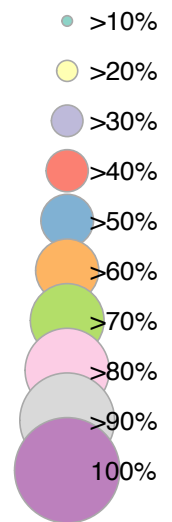
Incorrect response

The mean for the conceptual category is represented by the node size. Categories with large means are depicted with larger nodes.

The number of shared responses between categories is represented by the width of the edge connecting the category nodes. Two categories with a large number of shared responses with be connected with a wide edge.
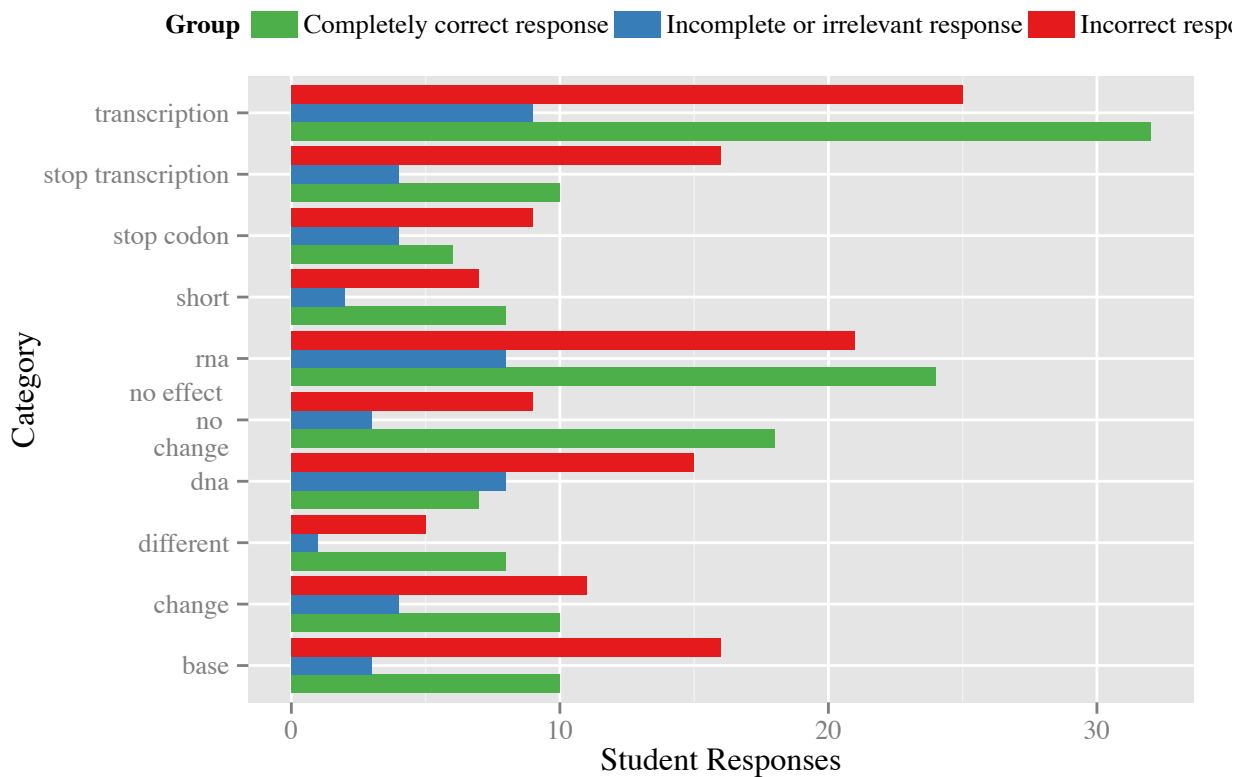
Frequency of Categories

Table 4: Category Descriptions

Category Name	Terms and Examples Included
base change	nucleotides change or are different
mutation	mutation or a named type of mutation
code	codes for, genetic code
copy and replicate	copies of DNA
strand - daughter	daughter strands, replicated strands, etc.
nonfunctional	terms like "broken", "doesn't work",'Doesn't function correctly", etc.

Confirmatory Analysis

Table 5: Discriminant Analysis

Rubric Level	Student Responses	Student Percentage (%)	Training Responses	Training Percentage (%)
Completely correct response	48	44	558.00	55
Incomplete or irrelevant response	20	19	215.00	21
Incorrect response	40	37	250.00	24
Total	108		1023.00	

Figure S2. Interview Protocol

Hello <u>Name</u>. Thank you so much for taking the time to meet with me today to continue discussing your participation in the AACR project. Everything you say today will be kept confidential, and all data will be made anonymous prior to dissemination. And, while your answers are helpful for my research, you may decline anything you do not wish to answer.

1. I'd like to start today with some general questions about the FLC group you have been participating in. In general, how is that going for you?

2. Do you want to continue participating in the AACR FLC?

3. Can you imagine anything that would make you want to stop participating in the AACR FLC?

4. What benefits are you receiving from participating in the FLC meetings?

5. Think about your participation over the past two years. What is the biggest benefit you have received? [ALTERNATIVE: Probe deeper into what they discussed in question 4].

6. Are there any ways you want the FLC to change?

Thank you. Now let's switch gears a bit and talk about AACR.

7. Now that you have been involved with the AACR project for over two years, can you tell me more about your impressions of the project? [Note: use their response to guide follow up questions and probe deeper into *why* they are responding a certain way].

8. What impact would you say the AACR questions have had on your teaching? What about the reports?

9. Now that you have had some experience with AACR, what would you say is the ideal use of AACR questions? [Probe deeper here, esp. if they mention assessment!]

10. How much insight into student ideas would you say the AACR reports have revealed?

11. Would you feel comfortable using AACR questions and reports on your own, without the support of the FLC?

12. Would you recommend AACR to a colleague? Why or why not? Tell me more about that.

13. At this point in the project, how comfortable are you with using technology and/or computers to analyze student writing?

Thanks. Now I'd like to shift to asking some general questions about your teaching.

14. Has your teaching changed at all in the past two years you have been participating in the AACR FLC?

15. How so? In what way? Tell me more about that.

16. IF YES: How much did the FLC influence the change?

17. IF NO: What could influence you to change your teaching?

18. How has the FLC impacted your teaching in the past two years?
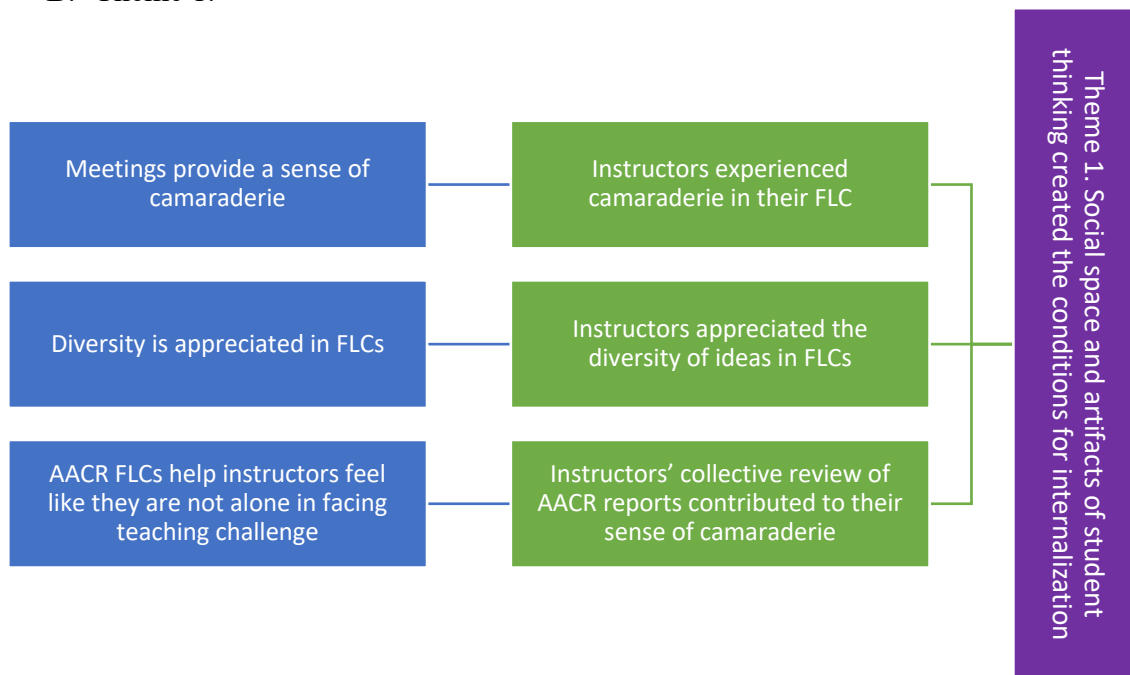
19. Have you at all changed the way that you prepare for class?

Figure S3. Relationship among codes and themes. The coding process used for this study is described in the main paper under Methods: Data Analysis. Themes and sub-themes are reported in the main paper under Results. This figure on this page and the next diagrams the correspondence among codes, sub-themes, and themes for each theme reported in Results.
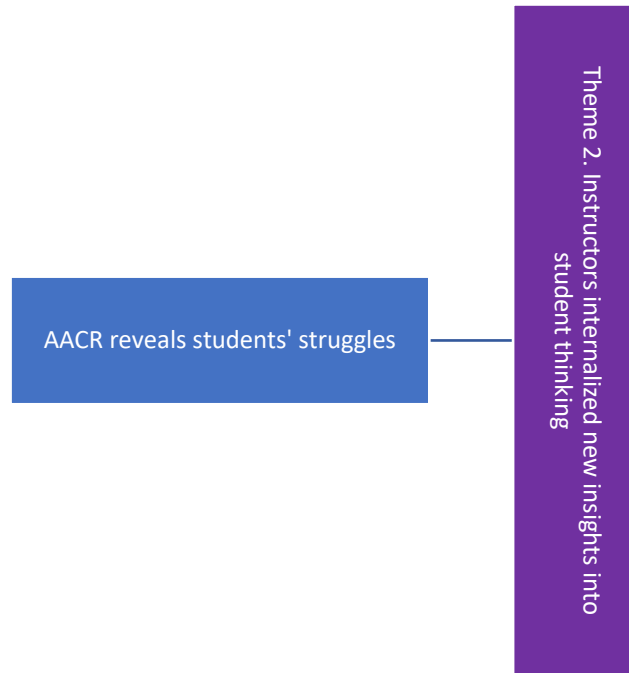
A. Overview of correspondence among codes, sub-themes, and theme.

B. Theme 1.

C. Theme 2.

Theme 2. Instructors internalized new insights into student thinking

AACR reveals students' struggles

D. Theme 3.

Theme 3. Instructors internalized questions and plans for improving teaching

Instructors use AACR questions to critique their own teaching

Instructors internalized questions about their teaching

Use assessment to inform teaching

Instructors use AACR questions to critique their own teaching

Instructors internalized questions and plans for improving teaching

Wants coordinated effort in tackling misconceptions

Instructors get ideas for classroom activities during FLC