# Supplemental Material

*CBE—Life Sciences Education*

**Auerbach and Schussler**

Supplemental Material

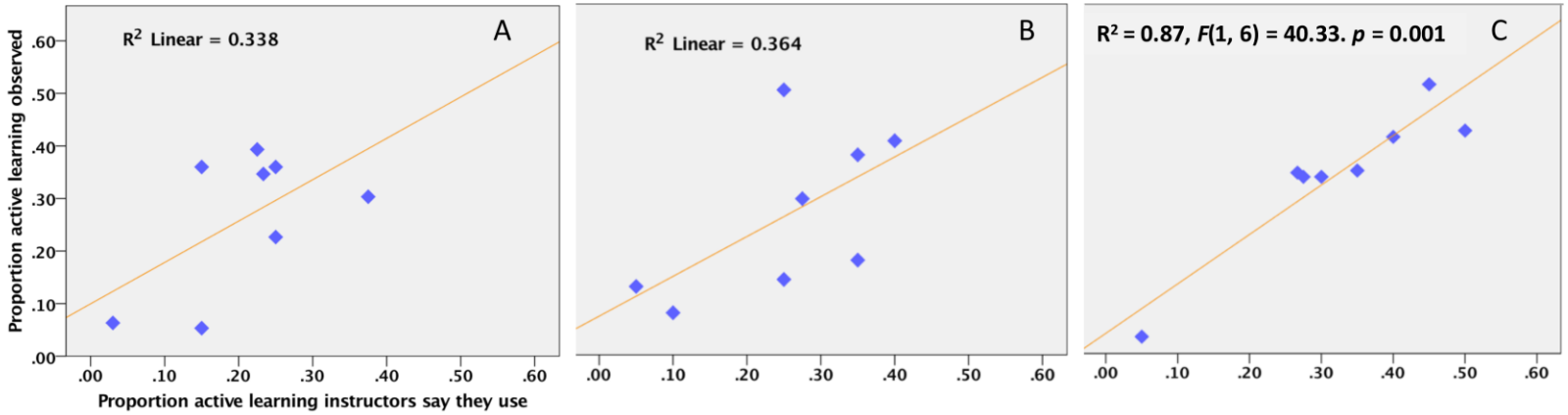

**Table S. Codebook**

*Categories are illustrated by listing and describing each theme and providing sample quotes. In some cases, a single quote may have been placed into more than one theme area.*

| Category | Theme | Code Description | Sample Quotes |
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| Course Planning | *instructor used previous course materials as a guide* | Instructors describe using previous course materials and/or the textbook as a starting place for designing a course or lecture. | *I start with the book and select topics, objectives, and how to teach them.* |
| | | | *I read sections of the book I have assigned to the students. From there I pick out the material that I think is most important for students to learn.* |
| | | | *So when I design a class, I typically go by the topics I want to cover which sometimes match the book, most of the time matches the book, then make the powerpoint.* |
| | | | *I essentially go through the book or other sources and pick out what I think are the important things and leave out the stuff that I don't think is important, the stuff that clutters, kind of streamline it a little bit.* |
| | | | *I go through the chapter and select what to keep.* |
| Course Planning | *instructor used learning objectives as a guide* | Instructors describe using learning objectives as a starting | *I start with specific learning objectives. What do I want them to do? How can I achieve that?* |

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| | | place for designing a course or lecture. | *Usually I start with what do I want the students to know at the end of the class. Basically, what are my learning objectives and then I try to design*<br><br>*What I've done with this semester is I explicitly backward designed my objectives for each class… I create learning objectives, explicit ones, that were more not just like to understand or to know but to write them the way I want them to know them on an exam.*<br><br>*One thing I did this year that I learned was to put in learning objectives and that helped me a lot, helped me to teach better and be better organized.* |
| Active Learning Implementation | *planned after lecture is set* | Instructor describes planning active learning approaches after they have prepared and completed their lecture planning. | *[*Active learning implementation*] is all retrospective. I go back now and try to figure out where to insert a clicker question.*<br><br>*After I get the lecture set, I try to find places to insert clicker questions where I can test them on information from the last lecture or something I just covered.*<br><br>*I design activities on the backend instead of the frontend. I also design questions for examples on the backend instead of the frontend.* |

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| | | | *So I give like a quick summary, especially for these connecting or continuing that lecture and then I'll go through the lecture, you know the powerpoints, so I use the Pearson powerpoints from the book but I cut down a lot of things and take the pictures from them and add my own but it's flow is mainly from the DVD, the CD they gave us. Then I add clickers.* |
| | | | *I try and focus on what I think is the most fundamental concept relevant to each of these topics and then how does that teach, how does that drive what else needs to be talked about with respect to that particular topic.* |
| Active Learning Implementation | *planned simultaneously with lecture content* | Instructor describes planning active learning implementation in concert with preparing the lecture. | *Any time I'm covering a concept that is difficult and I want students to get a chance to either think about it or talk about it on their own or whenever there is a natural point for them to do something and me to get feedback on whether or not they understand or whether they have questions, I think that, that should be driving when I do my activities more than just timing but yeah so I think both of those things honestly play a role in when I decide to integrate it.* |

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| | | | *In addition to just trying to make sure I'm not talking for long stretches of time, I think it's nice to have breaks from that but also any time I'm covering a concept that is difficult and I want students to get a chance to either think about it or talk about it on their own or whenever there is a natural point for them to do something and me to get feedback on whether or not they understand or whether they have questions, I think that, that should be driving when I do my activities more than just timing but yeah so I think both of those things honestly play a role in when I decide to integrate it.* |
| Active Learning Implementation | *planned lecture around AL* | Instructor describes using active learning implementation as a first step in planning their lecture. | *For each topic or concept I cover, I think about what questions and activities could help students learn the material better than lecturing.*<br><br>*The one thing I think I centered more about the activities I had, I think a set of activities that I like that worked well in the past. And so I basically designed around this.* |
| Active Learning Definition | *students engaged, involved, thinking about content* | Instructors talk about students being engaged with the content, typically in an individual context | *Students are engaged in thinking about content rather than just remembering it.*<br><br>*Students being engaged with the content and thinking about it in class.* |

*It means involvement, engagement, non-passive, doing things, thinking.*

*That the students are engaged, that they're not just sitting and listening or taking notes but that they are required to interact with each other or interact with me or to actively be doing something you know evaluating data, coming up with a hypothesis, talking to each other, answering questions, something like that.*

*So that means they need to do the learning themselves and not me. So basically, for me it's more the students have to do so they have to manipulate the concept, apply them to new situation, things like that.*

*When the students are thinking about the material and doing something with it.*

*It is when students are taking an active role in their own process of learning. They are working together to solve problems with the material.*

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| | | | *Practicing!! Giving them an opportunity to practice the things I want them to be able to do on the exam, which then are also the things I think are important to learn in the class so anything that gets them to think, consider, working together mainly just to think, to build their understanding.* |
| Active Learning Definition | *students interacting with each other* | Instructors describe student collaboration as a part of active learning. So they continue to talk about student engagement, but as part of a group. | *That the students are engaged, that they're not just sitting and listening or taking notes but that they are required to interact with each other or interact with me or to actively be doing something you know evaluating data, coming up with a hypothesis, talking to each other, answering questions, something like that.* |
| | | | *It is when students are taking an active role in their own process of learning. They are working together to solve problems with the material.* |
| | | | *Practicing!! Giving them an opportunity to practice the things I want them to be able to do on the exam, which then are also the things I think are important to learn in the class so anything that gets them to think, consider, working together mainly just to think, to build their understanding.* |
| Active Learning Definition | *students as knowledge constructors* | Instructors describe active learning as a process where | *Students building their own knowledge rather than being told facts.* |

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| | | students construct their own knowledge; it is going beyond engagement to cognitive changes | *So that means they need to do the learning themselves and not me. So basically, for me it's more the students have to do so they have to manipulate the concept, apply them to new situation, things like that.* |
| | | | *Practicing!! Giving them an opportunity to practice the things I want them to be able to do on the exam, which then are also the things I think are important to learn in the class so anything that gets them to think, consider, working together mainly just to think, to build their understanding.* |
| Active Learning Type | *instructor used group AL* | Instructors describe students working together to answer questions and solve problems in class. | *There's not a lot of individual, other than the clickers, well no actually cause I tell them to talk during clickers.* |
| | | | *Clickers, calling on students with verbal questions, small groups, and allow for students to share.* |
| | | | *Open-ended questions that lead to discussion, think-pair-share, clicker questions, handouts.* |
| | | | *Clickers, clickers with discussion. Just having students discuss something is something I've never ever done before and I've taught this four times.* |

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| | | | *I try whenever possible, try to find challenging questions that they can think about and I have them discuss it and we vote then discuss it, vote discuss, these kind of things*. |
| | | | *So this semester I didn't use clickers and frankly I didn't miss clickers and I don't have anything against them and I liked using them but this semester and I don't know how effective it was but I went with notecard approaches and group work on paper and they just turned that in and then I went over it and gave them participation points instead of actually grading it.* |
| | | | *I know I ask a lot of questions and I try to make them, I think I have gotten better about this, I try to give students a chance to talk about it in groups or in pairs before I get responses from students.* |
| | | | *Worksheets where they work together. Worksheets, they have to apply content from lecture notecards, questions from powerpoint to discuss, clickers with discussion, and I repoll if few are correct.* |
| Active Learning Type | *instructor did not report using group AL* | Instructors describe students not working together to answer questions and solve problems in class. | *Yeah…sorta zero.* |

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| Active Learning Type | *instructor used clickers* | Instructors describe students using clickers to answer questions and solve problems in class. | *There's not a lot of individual, other than the clickers, well no actually cause I tell them to talk during clickers.* |
| | | | *I use the clickers to review where we left off, assess preparedness, active learning, exams* |
| | | | *Clickers, calling on students with verbal questions, small groups, and allow for students to share.* |
| | | | *Open-ended questions that lead to discussion, think-pair-share, clicker questions, handouts.* |
| | | | *Clickers, clickers with discussion. Just having students discuss something is something I've never ever done before and I've taught this four times.* |
| | | | *Worksheets where they work together. Worksheets, they have to apply content from lecture notecards, questions from powerpoint to discuss, clickers with discussion, and I repoll if few are correct.* |
| Active Learning Type | *instructor used verbal questions* | Instructors describe students answering verbal questions about course content in class. | *Clickers, calling on students with verbal questions, small groups, and allow for students to share.* |
| | | | *Open-ended questions that lead to discussion, think-pair-share, clicker questions, handouts.* |

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| | | | *I try whenever possible, try to find challenging questions that they can think about and I have them discuss it and we vote then discuss it, vote discuss, these kind of things*. |
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| | | | *Worksheets where they work together. Worksheets, they have to apply content from lecture notecards, questions from powerpoint to discuss, clickers with discussion, and I repoll if few are correct.* |
| Active Learning Type | *instructor used activities* | Instructors describe students using activities (typically written activities) to answer questions and solve problems in class. | *Open-ended questions that lead to discussion, think-pair-share, clicker questions, handouts.* |
| | | | *This semester I've done three or four case studies where I have pulled from the Buffalo case study databank. Another activity we did a genetics worksheet where we did dominants and recessive, that was fun. We did an activity early on with DNA structure so students were given different components and had to orient a DNA molecule in the right orientation with the right components.* |

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| | | | *So this semester I didn't use clickers and frankly I didn't miss clickers and I don't have anything against them and I liked using them but this semester and I don't know how effective it was but I went with notecard approaches and group work on paper and they just turned that in and then I went over it and gave them participation points instead of actually grading it.* |
| | | | *Worksheets where they work together. Worksheets, they have to apply content from lecture notecards, questions from powerpoint to discuss, clickers with discussion, and I repoll if few are correct.* |
| Change in Teaching | *overall approach* | Instructors talk about how they see the reform impacting their overall teaching approach. | *Well, just the shift in thinking of how the material is presented so focusing not only the students but my attention on the fact that these are connected concepts rather than individual bite-sized pieces of information and so like I said the same basic content but put into a different context. It can be very different and I think it is much more effective to think about, teach about it in that connected context that it is discrete pieces of information.* |
| | | | *I think the whole process benefits some students, I'm not convinced it benefits all of them just because some kids are really introverted and don't feel comfortable participating and or are resistant or whatever to talk. Some kids weren't comfortable talking and I would just ask them hey can I call on you after hearing what their response was after think-pair-share.* |

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| | | *I think I'm going to have to put more things online so I'm going to have to learn how to utilize technology to capture what I used to do in class and put it online for them to look at.* |
| *time pressure* | Instructors express concerns about how a reduction in time for lecture would change the way they taught. | *I'll have to be more organized and less flexible, especially when we have the TA's lead the discussion section for one class each week. I will have less time to get the information to the students and will need to stick to my schedule.*<br><br>*It pushes me to cut out some details and just spend topic time on the harder to understand concepts.*<br><br>*We'll see next semester how it is, but I'm kind of worried about going from three lecture to two lectures. So I will have to cut down some of these clicker times and notecard times and put some of that to discussion time.* |
| *pedagogical strategies* | Instructors commented on changing the pedagogical choices they used in the classroom. | *It's basically hauled me out of my safety zone. Cause I like to lecture. I have fun. I've started using activities. I guess one other thing I've gotten better at is asking questions of the class and not answering it five seconds later myself.*<br><br>*I think you know if we talk about awhile ago I was not doing any of this, learning, active learning. I was not thinking too much about it. I think a lot more about what I would like, I'm more purposeful in the way I design my class. I'm thinking more about what do I want the students to know so this backward design, I'm doing this a lot more."* |

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| | *no change* | Instructors reported that the curriculum reform would not change their teaching. | *I don't, my teaching style is always evolving regardless.* |
| | | | *Not really because that's you know that's the whole, I don't think it will change. I think it's just going to change what percent is done outside of the class and what percent is done in the class.* |
| Assessment | | Instructors share reflections about what to test, how to test, and using assessment itself as an instructional strategy. | *I never did review before an exam but I think I should. I would like to add a review before exams and have another form of assessment, more evaluator-y quizzes.* |
| | | | *I'm still struggling with assessment in the course. I'm happier with my assessment this year.* [My TA] *helped me to revise how I ask question so that they are scenario based and so now I think that the assessment is much more in line with the activities that we do in class.* |
| | | | *I try to give them group activities where I have them apply concepts and I do in groups because I think it's too hard to do it on your own if you've never done it. So I think that the first thing and then I always test them in that on an exam so it's not like I have them do it and then forget about it. And they know it so they always apply to this.* |

*Really my exams are themselves a strategy. My first exam is a take-home. My second exam is in-class and then take-home, same exam, and then their score is the average and then the third exam it's time to now fly by yourself. I've always had a part of the exam that are questions that I project and they can talk amongst themselves.*

*I try to pick out things that I talked about and taught students in the past that I didn't end up testing them over very much cause I figured it's something that's not important enough for me to test them over or if it's really like difficult for me to test them on then that seems like an obvious thing to take out of the course.*

*I give a lot of analysis and interpretation and the students realize this. And I say look, I want you to be able to think this stuff but it is hard.*