

Supplemental Material

CBE—Life Sciences Education

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Supplemental Material for

Undergraduate student depression in active learning science courses

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Copy of interview script analyzed

Talking about Active Learning

We define an active learning course as a course where students are engaged in activities and/or discussions in class. This is in contrast to traditional lectures where the instructor just lectures at students and students just listen.

Have you taken a college science course that implements active learning?

If No: I am going to stop the interview here as we are only recruiting students who have taken an in-person science course that uses active learning. Thank you for your time.

Establishing depression and cause

Have you experienced depression while taking an in-person college science course that uses active learning?

If No: I am going to stop the interview here as we are only recruiting students who have experienced depression while taking an in-person science course that uses active learning. Thank you for your time.

Many people with depression also have extreme feelings of anxiety. Have you experienced extreme feelings of anxiety, either currently or in the past?

If Yes: Is there a link between your feelings of depression and anxiety?
Can you describe this? What tends to come first, anxiety or depression?

I'm going to ask you some specific questions about how active learning in in-person college science courses might affect your depression.

Effect of active learning on depression

What aspects, if any, of your active learning college science courses make your depression **worse**?

What aspects, if any, of your active learning college science courses **decrease** feelings associated with your depression?

I want to ask you about group work in in-person science courses. When I say group work, I'm talking about working with at least one other person during your college science class.

Have you ever had an instructor ask you to work in groups during an active learning college science course? **Y/N**

If Yes: Talk to me about how, if at all, the expectation to work in groups and connect with others in active learning college science courses can **worsen** your depression.

Talk to me about how, if at all, the expectation to work in groups and connect with others in active learning science environments can **decrease** feelings associated with depression.

- You mentioned ____ affecting your depression. Talk to me about how ____ affects the symptoms associated with your depression.

Now I want to ask about the use of polls or clicker questions in in-person science courses. When I say polls or clicker questions, I'm talking about students answering questions asked by the professor on a device throughout the course of the lecture.

Have you ever had an instructor use polls or clicker questions during an in-person active learning college science course? **Y/N**

If Yes: Talk to me about how, if at all, the expectation to participate in polls or clicker questions in active learning science environments can **worsen** your depression.

Talk to me about how, if at all, the expectation to participate in polls or clicker questions in active learning science environments can **decrease** feelings associated with depression.

- You mentioned ____ affecting your depression. Talk to me about how ____ affects the symptoms associated with your depression.

Now I want to ask about cold calling in in-person college science courses. When I say cold calling, I'm talking about an instructor who calls on students who don't volunteer to speak out in front of the class.

Have you ever had an instructor who calls on students who don't volunteer to speak out in front of the class in an in-person active learning college science course? **Y/N**

If Yes: Talk to me about how, if at all, cold calling/random calling by instructors in active learning science environments can **worsen** your depression.

Talk to me about how, if at all, cold calling/random calling by instructors in active learning science environments can **decrease** feelings associated with depression.

- You mentioned ____ affecting your depression. Talk to me about how ____ affects the symptoms associated with your depression.

Are there any other ways in which active learning college science courses affect your depression that we have not talked about?

Effect of depression on active learning

Now I'm going to switch gears. We've talked a lot about how active learning affects your depression, but now I want to ask you how your depression affects your experience in active learning courses.

Talk to me about how, if at all, your depression affects the process of learning content when you are in an active learning science environment?

Talk to me about how, if at all, your depression affects your social interactions when you are in an active learning science environment?

- You mentioned ____ affecting your learning experience in active learning courses. Talk to me about how ____ affects your ability to engage with the material or make connections with your peers or instructor in active learning science courses.

Are there any other ways in which depression affects your experience in active learning science environments that we have not talked about?

Post Interview Survey

*Thank you for taking the time to interview with us. We really appreciate it!
We would like you to take a quick (less than 5 minutes) survey to tell us more about your current feelings of depression and anxiety and a demographic survey. There are no right or wrong answers. Your answers will never be shared with anyone outside the research team.*

In total, how many in-person college science courses have you taken?

- 1-2
- 3-4
- 5-6
- 7 or more

In total, how many in-person college science courses have you taken that implemented active learning?

- 1-2
- 3-4
- 5-6
- 7 or more

How often have you been bothered by the following over the past 2 weeks? Indicate how frequently each has affected you on a scale from Not at all, Several days, More than half the days, or Nearly every day.

- Little interest or pleasure in doing things?
- Feeling down, depressed, or hopeless?
- Trouble falling or staying asleep, or sleeping too much?
- Feeling tired or having little energy?
- Poor appetite or overeating?
- Feeling bad about yourself – or that you are a failure or have let yourself or your family down?
- Trouble concentrating on things, such as reading the newspaper or watching television?
- Moving or speaking so slowly that other people could have noticed? Or so fidgety or restless that you have been moving a lot more than usual?
- Thoughts that you would be better off dead, or thoughts of hurting yourself in some way?

*For these interviews we are interested in the experiences **of all students, regardless of whether they have been formally diagnosed with depression, and regardless of whether they are being treated for depression.** Thus, there are no right or wrong answers to these questions. We are simply trying to learn more about your experience.*

On average, during your most recent experience in an in-person active learning class, in your opinion how severe was your depression?

- Mild
- Moderate
- Severe

Have you been diagnosed with depression?

- Yes
- No
- Decline to state

Are you currently being treated or have you previously been treated for depression?

- Yes
- No
- Decline to state

Over the last 2 weeks, how often have you been bothered by the following problems? Score each option on a scale from Not at all, Several days, More than half the days, or Nearly every day.

- Feeling nervous, anxious, or on edge
- Not being able to stop or control worrying
- Trouble relaxing
- Being so restless that it's hard to sit still
- Becoming easily annoyed or irritable
- Feeling afraid as if something awful might happen

I most closely identify as

- Man
- Woman
- Non-binary
- Other, please describe
- Decline to state

What year in college are you currently in?

- 1st year
- 2nd year
- 3rd year
- 4th year or greater

I most closely identify as

- American Indian or Alaska Native

- Asian
- Black or African American
- Hispanic, Latino, or Spanish origin
- Pacific Islander
- White
- Multiracial, please describe
- Other, please describe
- Decline to state

Where do you currently live?

- In the United States (Which state do you currently live in?)
- Internationally (Which country do you currently live in?)
- Other, please describe

I most closely identify as

- First generation college student whose parents' highest level of education is a high school diploma or less
- Non-first generation college student (at least one parent has some college)
- Non-first generation college student (at least one parent has finished college)
- Decline to state

What is your parent's highest completed level of education? If you have more than one parent with differing levels of education, choose the parent with the highest completion level.

- Less than high school completed
- High school diploma or GED
- Some college but no degree
- Associate degree (for example: AA, AS)
- Bachelor's degree (for example: BA, AB, BS)
- Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA)
- Higher than a Master's degree (for example: PhD, MD, JD)
- Other, please describe
- Decline to state

What is your best guess for the yearly income of the household in which you grew up?

- Low income (less than \$25,000)
- Middle-low income (\$25,000 – \$49,999)
- Middle income (\$50,000 – \$99,999)
- Middle-high income (\$100,000 – \$199,999)
- High income (\$200,000 or higher)
- Decline to state

Do you serve as a primary caregiver for someone other than yourself? (e.g., children, sick parent, other dependents)

- Yes
- No
- Decline to state

Please indicate the option that most closely reflects your college experience

- I transferred to this institution from a 2-year college, a community or junior college, or a technical college
- I transferred to this institution from another 4-year institution
- I started my college career at this institution
- If none of the above reflect your experience, please describe your experience:
- Decline to state

Do you identify as a member of the LGBTQ+ community? *lesbian, gay, bisexual, trans, queer/questioning

- Yes
- No
- Decline to state

[If yes] Please select the word or words that best describe your identity(ies) within the LGBTQ+ community.

LGBTQ+ identities referring to sexuality and/or romantic attraction

- Lesbian or Gay
- Bisexual
- Queer as it relates to my sexuality · Asexual
- Pansexual
- Other, please describe.
- Decline to state

LGBTQ+ gender identities

- Transgender man
- Transgender woman
- Gender-queer or gender non-binary
- Other, please describe
- Decline to state

I most closely identify as a(n)

- Military veteran
- Active Duty service member
- Military reserve
- Military family member or dependent, please explain
- None of the above

I most closely identify with

- Currently or having previously struggled with anxiety or anxiety disorder
- I have never struggled with an anxiety disorder
- Decline to state

I most closely identify with

- Currently or having previously struggled with depression or depressive disorder
- I have never struggled with depression
- Decline to state

Students with mental health diagnoses have rights to receive accommodations through their university. Colleges are required to provide accommodations based on Title II of the ADA such as testing accommodations. Your school should have a specific disability resource center that will help you get accommodations.

Below are further resources regarding the rights of students with mental health diagnoses at their university

https://www.ada.gov/regs2014/testing_accommodations.html

Leadership21 Committee. "Campus Mental Health Know Your Rights." Washington D.C.: Judge David L. Bazelon Center for Mental Health Law, 2008.

<https://secureservercdn.net/198.71.233.111/d25.2ac.myftpupload.com/wp-content/uploads/2017/01/YourMind-YourRights.pdf>

U.S. Department of Justice, Civil Rights Division, and U.S. Department of Education, Office for Civil Rights. "Supporting and Protecting the Rights of Students at Risk of Self-Harm in the Era of COVID-19," October 2021.

https://www.ada.gov/students_self-harm_fact_sheet.pdf

Full coding rubric of themes, descriptions, and percent of participants who mentioned each theme

Depression affecting students' experiences in active learning

Theme	Percent	Theme description
Difficulty engaging in social interactions	89.7	Student describes that depression can cause them to feel less confident in contributing to group discussions, often because they have low self-esteem. This makes it more difficult to interact with their peers overall. It can also make it difficult when one needs to mask how they're feeling to be perceived as socially appropriate.
Energy	69.0	Student describes that depression can decrease your energy, social energy, or make you tired, which can interfere with learning. It can also impact whether a student has the energy to attend class.
Focus	65.5	Student describes that depression can make it difficult to focus or to concentrate. Student describes that they are "in their head" and not paying attention during class because of their negative thoughts.
Increases self-doubt about intelligence	41.4	Student describes that depression can increase your self-doubt or insecurity, which causes you to think that you don't know anything or incapable of learning, which can prevent further learning.
Motivation	37.9	Student describes that depression can make it more difficult to be motivated or to want to engage in the work itself, or engage in any social interactions, which can result in a decrease in learning.
Memory	24.1	Student describes that depression can make it more difficult to remember or recall information.
Lack of patience/irritability	20.7	Student describes that depression can cause them to feel easily frustrated or angry, particularly when they are working with others in class.

Underlying aspects of active learning practices affecting students' depression

Theme	Percent	Theme description
Opportunities to compare self to others		
Exacerbated students' depression		
Opportunities to compare self to others student perceives are better than they are	75.9	Student describes that when working with others during class or seeing other students' responses there are opportunities for them to realize how they are performing compared to others. Student describes that when they see that a topic is greatly understood by others while they may not understand, it increases negative self-talk. Students discussed specific experiences with clicker questions where instructor displays histogram revealing that a great majority of students answered a question correctly while they did not. This can exacerbate depressive symptoms because it erodes their academic self-concept: they feel inferior to others in an academic sense.
Alleviated students' depression		
Opportunities to compare self to others student perceives they are similar to	48.3	Student describes that working with others during class or seeing other students' responses allows them to compare their performance to others. Students describe that this can decrease depressive symptoms in cases where other students are struggling too, describing confusion, and having incorrect thinking or misconceptions because it allows them to recognize they are not the only one struggling, which bolsters their academic self-concept. It also decreases feelings of isolation.
Inherently social		
Exacerbated students' depression		
Opportunities to be negatively evaluated	72.4	Student describes that active learning provides opportunities to be judged by others during active learning practices such as group work and cold calling. Specifically, students worried about being judged for their lack of contribution or negative contributions during group work. During cold calling, students' feared evaluation of their appearance, mannerisms, or way of speaking. Students' concerns included being viewed as not smart, incompetent, useless, or not worthy of being in the class. Students described that contributing in class is a vulnerable experience. These instances increased fear of negative evaluation and anxiety which in turn exacerbated students' depressive symptoms.
Struggling to socialize	62.1	Student describes that active learning is inherently social which can present challenges such as struggling to find a group to work with, struggling when a partner is absent, struggling to connect with others, or having negative social interactions in general. This also includes experiences where students feel they must conceal or "mask" their depression by

		acting “normal” or happy. This can exacerbate depressive symptoms because it increases feelings of isolation.
Opportunities to be microaggressed, stereotyped, and feel othered	20.7	Student describes that active learning practices such as group requires interactions with others which allows for opportunities for them to realize they are demographically different from those around them. This allows for opportunities to be othered because they hold an underserved identity. Students also described experiences where they are microaggressed or stereotyped due to how they identify (e.g., lower socioeconomic status, first generation, background, gender, etc.). This can exacerbate depressive symptoms because student may feel othered.
Potential to slow down or hinder others	17.2	Student describes that when they are working with others in active learning, and they cannot think or work at the same pace as others they may hinder students in their group by impacting their grade, pace, or quality of work. This includes a sense of pressure to perform well for the sake of group members. This can exacerbate depressive symptoms by the student spending time focusing on how they cannot contribute effectively or how they are hindering other students which increases negative self-talk.
Alleviated students’ depression		
Positive experiences socializing	79.3	Student describes that active learning provides opportunities to connect with others, meet people, talk, or form friendships. This can decrease depressive symptoms because it can decrease feelings of isolation, improve motivation, and increase the extent to which a student feels like they belong in class and in science more broadly
Social academic support	37.9	Student describes that active learning classrooms provide a structure where students can work with others who can help if the student is struggling. This also applies to students who are not necessarily struggling but appreciate the opportunity to further their knowledge by talking with peers, which is less pressure than reaching out to their instructor. Students also describe instances when their peers as a question they also have, which decreases pressure on that student. This can decrease depressive symptoms by providing a sense of security that a student will not fail and has support from their peers.
Opportunities to “feel heard”	17.2	Student describes that active learning can provide the opportunity to contribute to discussions in a way where they “feel heard” by their peers or instructors. This can decrease depressive symptoms by making the student feel that their contributions are substantial and important, or they are worthy of others’ attention. This can in turn increase the feeling of belonging within the scientific community.

Frequent formative assessments		
Exacerbated students' depression		
Frequent opportunities to fail	69.0	Student describes that active learning provides opportunities for them to invalidate their intelligence through failure. This included getting a question wrong or contributing something wrong in class. Students also brought up experiences where instructors note that their response is incorrect which further exacerbated feeling associated with failure. This can exacerbate depressive symptoms because it has a negative affect on students' self-efficacy as a science student.
Alleviated students' depression		
Frequent opportunities to succeed	44.8	Student describes that active learning provides opportunities for their intelligence to be validated or their perceptions of their intelligence to be improved. This includes getting a question correct or positively contributing to a group discussion. This can decrease depressive symptoms because it has a positive effect on students' self-efficacy as a science student.
Inherently engaging		
Exacerbated students' depression		
Expectation to engage	55.2	Student describes that active learning comes with increased number of assignments both within the class and outside it. It also requires them to pay attention at a specific point in time where they cannot "space out" or sit back and participate passively. This can exacerbate depressive symptoms by decreasing their ability to recover from a depressive episode because they are focusing on engagement rather than their mental health. Students also described that active learning practices often come with attendance requirements and there can be instances that depression makes it difficult to attend class. Furthermore, students highlighted that the requirement to engage is especially hard with depression because depression impacts students' cognitive domains. Students also described that active learning courses are faster paced.
Alleviated students' depression		
Expectation to engage	55.2	Student describes that active learning requires their attention when engaging. This can decrease depressive symptoms by serving as a distraction from depressive thoughts and allowing them to "get out of their head." Alternatively, it may decrease depressive symptoms because it helps with motivation and focus. Students also described that some active learning practices such as clickers allow them to practice problems and engage with the material anonymously, which gives them a reflection of how they are performing in class and keeping up with the material without fear of judgement.