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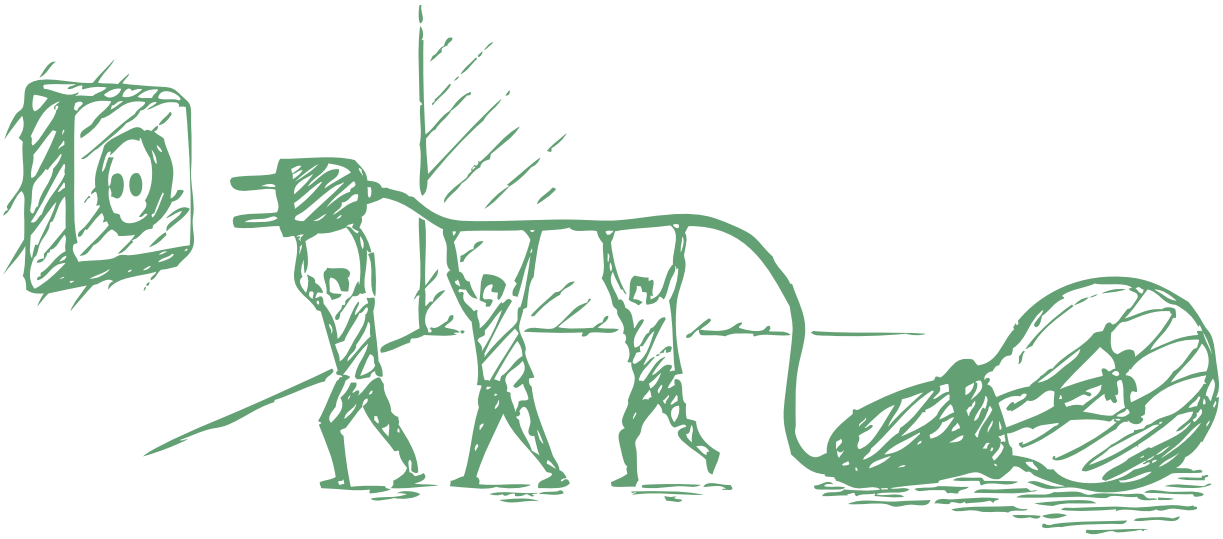
IS THERE A RELATIONSHIP BETWEEN STUDENT RESILIENCE *and* RESISTANCE TO ACTIVE LEARNING?



"To teach is to engage students in learning."
-Christensen, Garvin, & Sweet (1991, foreword, xiii)-

Annotated Bibliography
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for the CTL Faculty Learning Community on Active Learning and for credit in the FGSR Graduate Teaching and Learning Program Level 4

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Is there a relationship between student resilience and resistance to active learning?

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Contents

Definitions

Active learning: Any activity encouraging students to participate in learning approaches engaging them with course material and enhancing critical thinking as they make applications beyond the classroom (Lumpkin et al., 2015, p. 123); the goal of active learning strategies is to help create life-long learners who are flexible problem solvers and who can select, organize, and use information appropriately in new situations (Pinto & Sales, 2008)

Classroom engagement: Includes collaborative learning, problem-based learning, or cooperative learning (Hyun et al., 2017, as cited in Adkins, 2018); for example, exploratory writing assignments, small group and pair discussions, minute papers, oral reports, research modelling, role playing, case studies, drawing/mapping exercises, student-generated questions, or muddiest point, empty outline, directed paraphrasing, or key to class activities

Direct instructional guidance: Providing information that fully explains the concepts and procedures that students are required to learn as well as learning strategy support that is compatible with human cognitive architecture, wherein learning is defined as a change in longterm memory; examples include providing students with "worked examples" or "process worksheets" (Kirschner et al., 2010)

Durable learning: Creates knowledge that can be recalled over long periods of time, not just immediately after study (Arbuthnott & Krätzig, 2015)

Flexible learning: Having memories that can be recalled in a variety of situations and for a variety of purposes, not only in the context of the original learning situation (Arbuthnott & Krätzig, 2015)

Formative assessment: When a teacher uses information from an assessment to track learning, give students feedback, and adjust instructional strategies in a way intended to further progress toward learning goals (Greenstein, 2010, p. 29)

Learner-centered emphasis: A model in which students are actively engaged in the learning process (Baxter & Gray, 2001, as cited in Brown Wright, 2011)

Minimal instructional guidance: Students, rather than being presented with essential information, must discover or construct essential information for themselves; offered in the form of process- or task-relevant information that is available if learners choose to use it and involves discovering the solution to a problem in an information-rich environment (Kirschner et al., 2010)

Resilience: The attitudes and behaviors that enable learners to positively respond to new or challenging situations and take risks in learning (Cassidy, 2015, and references therein) (Note: According to Cassidy (2015), there is no conceptual or operational consensus for the definition of psychological resilience.)

Definitions

Student resistance: Constructive or destructive student behavior that is in opposition to the instructor (Richmond and McCroskey, 1992) (Note: Seidel & Tanner (2013) suggest using the term "student barriers" instead to better empathize with the challenges students face)

Teacher-centered emphasis: Where a faculty member lectures and students sit passively in class (Lumpkin et al., 2015, as cited in Adkins, 2018)

1. Introduction: Review of Effective Teaching

Arbuthnott, K. D.; Krätzig, G. P. Effective Teaching: Sensory Learning Styles versus General Memory Processes. *Compr. Psychol.* 2015, *4*, 1–9, doi:10.2466/06.IT.4.2.

- General memory processes overshadow differences in learning styles in students
- Teachers should focus primarily on using strategies that support knowledge integration and recall, such as adjusting instruction to accommodate students' levels of prior knowledge and experience, using frequent assessments, and distributing instruction over longer periods of time
- *Integrative elaboration:* Provide students with the necessary background information prior to any lesson, ideally in a step-by-step manner; use different techniques that prompt students to actively integrate new information in the context of their previous knowledge
- *Retrieval practice:* Use frequent formal and/or informal assessments, requiring students to access information more regularly so that it can be organized into associative webs of knowledge rather than existing on a solitary and soon-forgotten island
- *Distributed learning:* Allow students time to digest new information; repeatedly review previously taught materials and concepts, integrating them into future lessons and encouraging students to use their new knowledge creatively and collaboratively to solve current problems
- Tailoring instruction to processes that operate similarly for everyone (such as integrative elaboration and retrieval practice) can improve the competence and skill of all students

Brown Wright, G. Student-centered learning in higher education. *Int. J. Teach. Learn. High. Educ.* 2011, *23*, 92–97, doi:10.1080/03075079312331382498.

- Teachers should share power with students from the start to empower students and increase their confidence and self-motivation; for example, teachers can provide students with a list of assignments from which they choose a specified number that they will do
- The need to "cover" content too often leads to a neglect of ensuring that the course objectives are being met
- Too much content in a course can force students to resort to mere memorization tactics
- The slower pace required for active-learning strategies distributes learning over a longer period of time and increases constructive interaction and critical thinking
- Students should be viewed not as empty vessels to be filled with knowledge but as seekers to be guided along their intellectual developmental journey
- In-class activities which involve students provide faculty with opportunities to help guide them in clarifying their understanding and in assimilating the subject matter in meaningful ways

- Learner-centered methods require students to take responsibility for their learning by being actively involved in the learning process rather than simply passively receiving information from a lecture
- Students were most successful in completing college when they had high academic control and took appropriate actions to avoid failure
- Evaluation in the student-centered classroom is not just to generate grades but, more importantly, to promote learning
- Additional challenges are posed by student-centered methods of content delivery, such as additional preparation time and the challenge of ceding power while still facilitating and regulating

Kirschner, P. A.; Sweller, J.; Clark, R. E. Why Minimal Guidance During Instruction Does Not Work. *Educ. Psychol.* 2010, *41*, 75–86, doi:10.1207/s15326985ep4102.

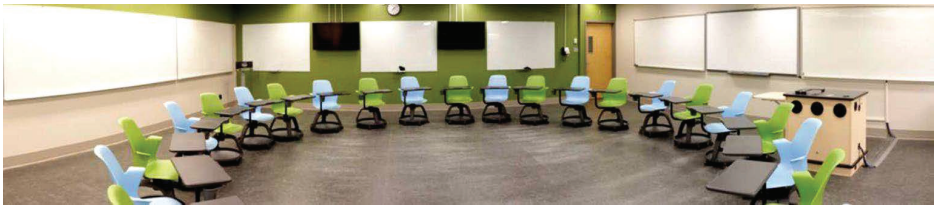
- Minimal guidance during instruction is significantly less effective and efficient than guidance specifically designed to support the cognitive processing necessary for learning
- Instruction needs to be designed according to the characteristics of working memory, long-term memory, and the intricate relations between them
- Engaging in cognitive activities with minimal instructional guidance is highly unlikely to result in effective learning for students
- Minimal instructional guidance requires novice learners to search for problem solutions using a limited working memory and does not clearly facilitate change in long-term memory
- Direct instruction involving considerable guidance, including examples, resulted in vastly more learning than discovery
- It is important to provide novices in an area with extensive guidance because they do not have sufficient knowledge in long-term memory to prevent unproductive problemsolving search
- Instructor guidance can be relaxed only with increased expertise as knowledge in longterm memory can take over from external guidance
- Examples of instructor guidance include providing students with "worked examples" or "process worksheets"
- Discovery learning is successful only when students have prerequisite knowledge and undergo some prior structured experiences
- There is a difference between learning a discipline and research in the discipline or, in other words, the practice of a profession is not the same as learning to practice the profession
- To achieve expertise in a domain, learners must acquire the necessary schemata that allow them to meaningfully and efficiently interpret information and identify the problem structure
- Evidence from controlled studies overwhelmingly supports strong instructional guidance rather than minimal guidance during the instruction of novice to intermediate learners, while they were equally effective for students with considerable prior knowledge
- Minimal guidance instruction can lead to students acquiring misconceptions or incomplete or disorganized knowledge

2. Active Learning: Theories, Evidence, and Strategies

Adkins, J. K. Active Learning and Formative Assessment in a User-Centered Design Course. *Inf. Syst. Educ. J.* 2018, *16*, 34–40.

- Lectures promote the skills of "remembering" and "understanding," but are less effective for keeping students engaged
- Active learning helps students better comprehend and recall new content by connecting thinking and doing
- Collaborative activities increase student critical thinking, provide feedback, and can stimulate student interest in the subject
- There is a positive correlation between the number of active learning methods incorporated in a classroom and student satisfaction
- Formative assessments create a feedback loop that allows students to assume greater responsibility for their own learning while also allowing teachers to adjust and plan for future instruction through data-driven decisions
- The best classroom environments for learning are engaging to students and well-regulated by teachers

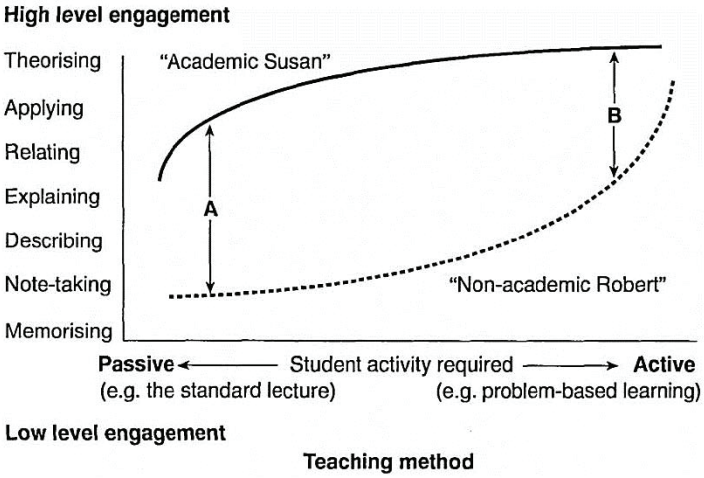
Benoit, A. Monitoring Implementation of Active Learning Classrooms at Lethbridge College, 2014-2015. *J. Learn. Spaces* 2017, *6*, 14–25.

- Classrooms should be optimized for creating and making, where students learn disciplinary knowledge and competencies such as teamwork and collaboration
-  ← round room
-  ← node room
- **Table 3. Interaction. Student and Instructor Results.**

Question	Round Rooms (n=96)	Node Rooms (n=24)	Requested (n=16)	Not Requested (n=15)
Positively changed student-to-student interaction	69% Agree 16% Disagree	70% Agree 10% Disagree	94% Agree 6% Disagree	80% Agree 7% Disagree
Positively changed student interaction with the instructor	33% Agree 44% Disagree	50% Agree 10% Disagree	75% Agree 6% Disagree	47% Agree 27% Disagree
Positively changed instructor interaction with students	38% Agree 39% Disagree	45% Agree 15% Disagree	81% Agree 6% Disagree	53% Agree 30% Disagree

- Close proximity and seating orientation at round tables enhances student collaboration

Biggs, J. What the student does: Teaching for enhanced learning. *High. Educ. Res. Dev.* 2012, *31*, 39–55, doi:10.1080/07294360.2012.642839.



- Education is about a conceptual change, not just the acquisition of information
- Conceptual change takes place when:
    1. The objectives are clear to students (and teachers), and they are embedded in the assessment tasks
    2. Students experience motivation as a product of good teaching
    3. Students feel free to focus on the task rather than pressured by ill-conceived and urgent assessments
    4. Students can work collaboratively with others, engaging in good dialogue that elicits the activities that shape, elaborate, and deepen understanding

Camacho, D. J.; Legare, J. M. Opportunities to Create Active Learning Techniques in the Classroom. *J. Instr. Res.* 2015, *4*, 38–45.

- Learning by simulation helps students to develop critical thinking skills and to inform future problem solving
- Active learning exercises allow students to review, analyze, and synthesize information to demonstrate mastery and understanding of the materials
- Promoting creativity in the classroom helps to produce a more diverse approach to problem solving in other areas
- Incorporating active learning strategies into the classroom produces a more effective learning environment and increased student participation and engagement

Demirci, C.; Yavaslar, E. Active learning: Let's make them a song. *Cypriot J. Educ. Sci.* 2018, *13*, 288–298.

- The age of information emphasized an education focused on analytical thinking; however, creativity is more relevant to the emerging conceptual age
- The most important skill set the new generation needs is to be able to organize facts by communicating and cooperating with other professionals, as well as to be able to discover new information and create novel ideas

- The fact that classical education focuses on events, memorization, basic skills, and exams is not suitable for the development of creativity
- Active learning can be used in order to help students improve their creativity
- The retention of new information and ideas will be better when students have more opportunities for talk, practice, or experience in the classroom
- Learning is made more enjoyable and more permanent through active learning strategies

Dyer, J. O.; Elsenpeter, R. L. Utilizing quantitative analyses of active learning assignments to assess learning and retention in a general biology course. *Bioscene* 2018, *44*, 3–12.

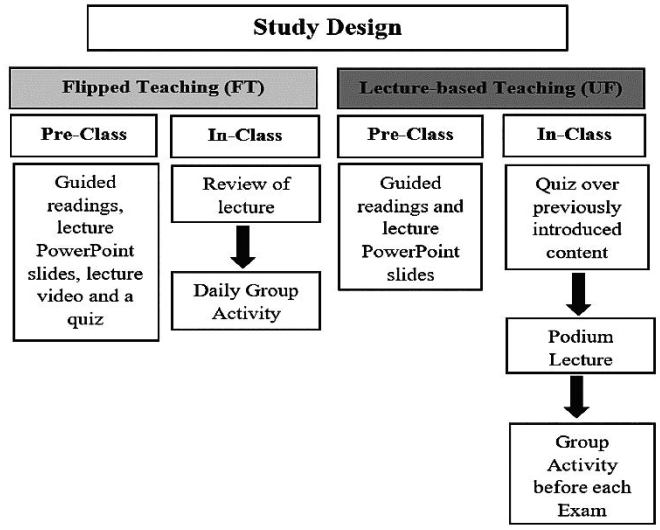
- Beyond increased student learning and retention of material, a switch to group-based, active-learning classrooms generally leads to increases in positive student attitudes toward material and courses
- Active learning improves student confidence of material
- Improvements in overall confidence and satisfaction of students has been shown to increase retention
- However, not all active learning assignments increase class learning and retention

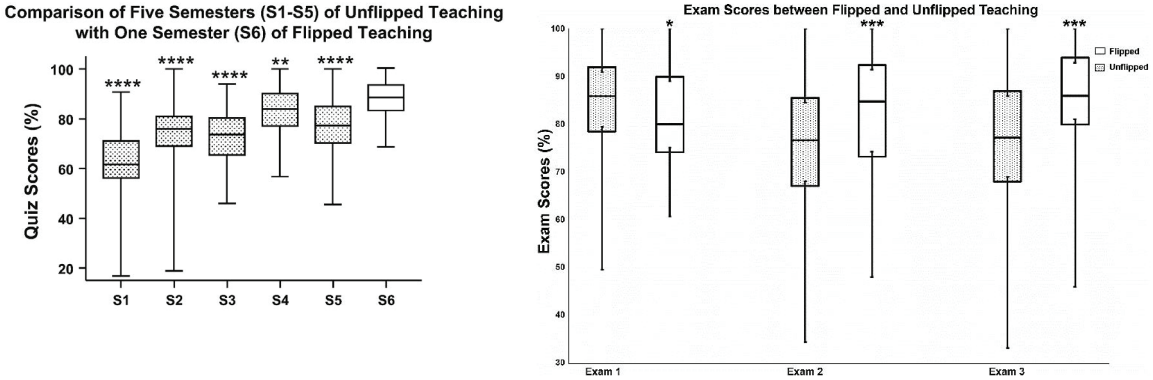
Freeman, S.; Eddy, S. L.; McDonough, M.; Smith, M. K.; Okoroafor, N.; Jordt, H.; Wenderoth, M. P. Active learning increases student performance in science, engineering, and mathematics. *Proc. Natl. Acad. Sci.* 2014, *111*, 8410–8415, doi:10.1073/pnas.1319030111.

- Meta-analysis of 225 studies comparing examination scores or failure rates for undergraduate students in STEM courses under traditional lecturing vs active learning
- Average examination scores improved by about 6% in active learning sections
- Students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning
- Active learning increases scores on concept inventories more than on course exams
- Active learning appears effective across all class sizes, but the greatest effects are seen in smaller classes with $\leq$50 students
- Results support active learning as the preferred, empirically validated teaching practice in regular classrooms

Gopalan, C. Effect of flipped teaching on student performance and perceptions in an Introductory Physiology course. *Adv Physiol Educ* 2019, *43*, 28–33, doi:10.1152/advan.00051.2018.

- Flipped teaching can offer a solution to the concern of adequate content coverage
- Studies have shown that students are more prepared and engaged while in a flipped teaching classroom setting than in a traditional classroom

- 

- 

- Student quiz scores were improved in the flipped teaching classroom
- Student exams scores were lower for the first exam and higher for the second two exams in the flipped teaching classroom, indicating that students need time to adjust to the flipped teaching style
- Most students view the flipped teaching method positively, and these student-centered strategies brought valuable differences to their performance

Hood Cattaneo, K. Telling Active Learning Pedagogies Apart: From theory to practice. *J. New Approaches Educ. Res.* 2017, *6*, 144–152, doi:10.7821/naer.2017.7.237.

- Distinct active learning pedagogies include:
    1. *Problem-based:* Learners use the process of problem solving through self-directed and/or group research to explore and solve various types of problems in need of solutions
    2. *Discovery-based:* A student directed knowledge creation process with boundaries defined by the student
    3. *Inquiry-based:* Follows the steps of the scientific process, ensuring that students are directing their learning and that teachers are available to scaffold student capacities to move from a confirmation to an open inquiry skill stage

4. *Project-based:* Focuses on issues and problems affecting students and their communities, explored through an interdisciplinary lens, in a way that allows for knowledge transferability, in small collaborative groups, with authentic assessments (i.e., specific student output in the form of a project)
5. *Case-based learning:* Involves exploring, diagnosing, problem-solving to apply new information to different contexts, and repeating to reach understanding and store the new information

- In general, teacher scaffolding (as an expert, guide, or facilitator) should occur at every level of learning towards a student-led learning approach
- Pure discovery learning should be reserved for expert knowledge explorers with extensive experience and expertise
- Teacher guidance includes context setting, instruction and modelling of methods, and provision of content information including manuals, simulations, feedback, and example problems

Hyun, J.; Ediger, R.; Lee, D. Students' Satisfaction on Their Learning Process in Active Learning and Traditional Classrooms. *Int. J. Teach.* 2017, *29*, 108–118.

- Students' satisfaction both with their individual and group learning process was positively affected by active learning pedagogical activities both at the under-graduate and graduate level
- Although classroom design may help enhance active learning pedagogical activities, intentional implementation of active learning pedagogy can enhance students' satisfaction with their learning process no matter where one is teaching
- In general, more engagement methods would be appreciated by students regardless of the subject matter or the objectives of the class
- Even in low-technology classrooms, learning can be promoted and enhanced with intentional implementation of active learning pedagogy activities by faculty

Johnson, D. W.; Johnson, R. T.; Smith, K. A. Cooperative Learning Returns To College What Evidence Is There That It Works? *Change* 1998, *July/Aug*, 27–35, doi:10.1080/00091389809602629.

- Five basic elements have emerged as critical to cooperative work in classrooms:
    1. Positive interdependence
    2. Individual accountability
    3. Face-to-face promotive interaction
    4. Social skills
    5. Group processing
- Research evidence indicates that
    1. The theories underlying cooperative learning are valid
    2. Cooperative learning works in college classrooms
- Creative genius is the product of, and best develops within, cooperative efforts

Joseph Lobo, G. Active learning interventions and student perceptions. *J. Appl. Res. High. Educ.* 2017, *9*, 465–473, doi:10.1108/JARHE-09-2016-0061.

- Contemporary universities are more dedicated to consumption than to learning
- Learning by doing is the epitome of active learning
- Active learning techniques should help students make meaningful connections between their own thinking and what they are learning in order to retain and incorporate new knowledge
- Empirical and theoretical research overwhelmingly supports the worth of active engagement for increased learning and development of higher-order cognitive skills
- Collaboration has been shown to aid learning, insofar as social connections can motivate learners to learn
- In other words, doing—and doing together—should lead to the activation of higher cognitive processes and improved, authentic learning

Lumpkin, A.; Achen, R.; Dodd, R. Student perceptions of active learning. *Coll. Stud. J.* 2015, *49*, 121–133, doi:10.1177/1469787407074008.

- To keep students focused and engaged, lectures should be punctuated by a diversity of learning activities at least every 10-15 minutes
- The literature specifically supports the use of exploratory writing activities to increase student learning, as well as the use of small-group discussions to enhance student engagement and learning
- Adding more exploratory writings increases students' understanding of key concepts and helps them reason through difficult topics while building on existing knowledge
- Small-group discussions can be enhanced through greater clarity by aligning learning outcomes with assigned tasks, requiring note taking by every student, reporting to the class the key points of discussions, sharing findings with non-group members, or submitting a written report from each group

Markant, D. B.; Ruggeri, A.; Gureckis, T. M.; Xu, F. Enhanced Memory as a Common Effect of Active Learning. *Mind, Brain, Educ.* 2016, 1–11, doi:10.1111/mbe.12117.

- Active learning should allow students to have the opportunity to exert control over the learning experience, including the selection, sequencing, or pacing of new information
- Active control has positive effects on memory across a wide range of activities and student populations
- Even when limited to relatively simple interactions with a set of stimuli, active control is typically associated with improved memory
- The use of interactive, simulation-based instruction also results in positive student learning outcomes
- What kinds scaffolding are necessary to ensure understanding and retention of the content while fostering students' ability to learn in a self-directed manner?

    1. Instruction should not impose unwarranted cognitive demands simply to adhere to an idealized vision of active learning

2. For example, a complete lack of feedback or guidance will tend to produce poor outcomes for most students
3. On the other hand, a complete absence of control during learning may render even the best direct instruction less memorable

McConnell, D. A.; Chapman, L.; Czaijka, C. D.; Jones, J. P.; Ryker, K. D.; Wiggen, J. Instructional Utility and Learning Efficacy of Common Active Learning Strategies. *J. Geosci. Educ.* 2017, *65*, 604–625, doi:10.5408/17-249.1.

	Pre-Class Preparation			*In-Class Actions*			*Task Characteristics*				
	Instructor prep time:	Required resources:	Availability of examples:	Ease of student use:	Student interaction:	Assessment ease:	Class time needed:	Class size limitations:	Potential use frequency:	Research validated:	**Total score**
Peer Instruction	3	3	3	3	3	3	3	3	3	6	**33**
Think-pair-share	3	3	3	3	3	3	3	3	3	2	**29**
Minute Papers	3	3	3	3	1	2	3	3	3	4	**28**
Lecture Tutorials	2	3	2	3	2	2	2	3	2	5	**26**
Concept Maps	3	3	2	2	2	2	2	3	2	5	**26**
Concept Sketches	2	3	2	2	2	2	2	3	2	2	**22**
Case Studies/Problems	1	2	3	2	2	1	1	3	1	5	**21**
Jigsaw	2	2	2	2	3	2	2	2	1	3	**21**
Teaching with models	1	1	2	2	2	2	2	2	2	5	**21**
Gallery Walks	2	2	2	2	3	2	1	2	1	1	**18**
Role Playing	1	2	1	1	3	1	1	1	1	1	**13**

- ^Strategy utility and learning efficacy scores combined to yield a total strategy score
  - *Utility:* Each strategy was reviewed against a common set of instructional criteria, including pre-class preparation, student strategy use, and task characteristics; strategies that have a high utility have a number of features that make them easy to use (e.g., they are straightforward to prepare, examples are readily available, and they can be used frequently during a lesson in any size classroom)
  - *Learning efficacy:* Considers the robustness of the research evidence in favor of improved student performance as a result of the application of a teaching strategy

	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Peer Instruction						
Think-pair-share						
Minute Papers						
Lecture Tutorials						
Concept Maps						
Concept Sketches						
Teaching with models						
Jigsaw						
Case Studies/Problems						
Gallery Walks						
Role Playing						

- ^Classification of strategies by Bloom's taxonomy (dark gray boxes indicate Bloom's level of the most common application or applications of activity; light gray boxes indicate Bloom's level of less common applications of the activity; white boxes indicate activity does not typically incorporate that level of Bloom's taxonomy)

- *Peer Instruction:* A strategy in which an instructor follows a lecture segment by posing a conceptual multiple-choice question that focuses on a single key concept, students answer the question individually (using any number of techniques), and instructors evaluate the responses; students then discuss their answers in pairs or small groups and vote again, at which point the instructor reevaluates the responses and provides an explanation for the correct answer
    - A strategy with high utility and high learning efficacy
- *Think-Pair-Share:* A strategy designed to get students talking to each other about course content in response to an instructor prompt
    - A strategy with high utility and low learning efficacy
- *Minute Papers:* Brief, flexible exercises during which students have an opportunity to reflect on and write about course content
    - A strategy with high utility and moderate learning efficacy
- *Lecture Tutorials:* Structured prompts to which students provide written feedback
    - A strategy with moderate utility and high learning efficacy
- *Concept Maps:* A graphical representations of one's knowledge of a topic that stress the similarities and connections among various ideas and concepts
    - A strategy with moderate utility and high learning efficacy

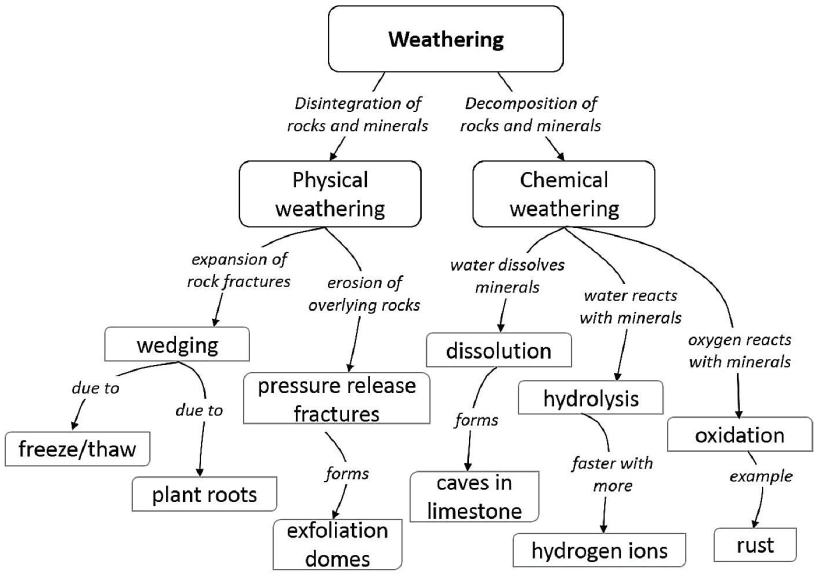


FIGURE 1: Example of a concept map for weathering.

- *Concept Sketches:* An illustration of the main aspects of a concept or system, annotated with concise but complete labels
    - A strategy with moderate utility and low learning efficacy

- *Case Studies/Problem-Based Activities:* Stories that present realistic, complex, and contextually rich situations and often involve a dilemma, conflict, or problem that needs to be solved and may involve collaborative work with peers and the instructor
    - A strategy with moderate utility and high learning efficacy
- *Jigsaw Activities:* A collaborative learning technique that tasks individual students with becoming experts on certain information that they then share with other expert peers in a group to build a deeper conceptual understanding
    - A strategy with moderate utility and moderate learning efficacy
- *Teaching with Models:* A strategy in which students handle physical models (i.e., systems of objects or symbols) or an instructor manipulates models during lecture demonstrations to communicate concepts and represent complex ideas and systems
    - A strategy with moderate utility and high learning efficacy
- *Gallery Walks:* Analogous to walking through a gallery to view works of art, except that this strategy requires viewers to record an explicit response to each piece
    - A strategy with moderate utility and low learning efficacy
- *Role Playing:* A simulation activity that asks students to take on the roles of people who will affect, or be affected by, a topic or phenomena
    - A strategy with low utility and low learning efficacy

Mohamed, A.-R. Effects of Active Learning Variants on Student Performance and Learning Perceptions. *Int. J. Scholarsh. Teach. Learn.* 2008, *2*, 1–15, doi:10.20429/ijsotl.2008.020211.

- Students performed best on content taught by collaborative learning, which was a milder active learning module compared to process-oriented guided inquiry learning
- Student engagement in content, higher-order thinking, and process skills were higher under the process-oriented guided inquiry learning module than the collaborative learning or traditional lecturing modules
- 67% of the students chose collaborative learning when prompted to pick a learning module between collaborative, process-oriented guided inquiry learning, or traditional

Prince, M. Does Active Learning Work? A Review of the Research. *J. Eng. Educ.* 2004, *July*, 223–231.

- Although the results vary in strength, this study found support for all forms of active learning examined, including collaborative, cooperative, and problem-based learning
- Active learning is beneficial for student engagement, and students will remember more content if brief activities are introduced to the lecture
- The best available evidence suggests that faculty should structure their courses to promote collaborative and cooperative environments

- Problem-based learning modules emphasize different elements, some more effective for promoting academic achievement than others
- Faculty adopting problem-based learning modules are unlikely to see improvements in student test scores, but are likely to positively influence student attitudes and study habits
- Students in problem-based learning classrooms may also retain information longer and perhaps develop enhanced critical thinking and problem-solving skills, especially if problem-based learning is coupled with explicit instruction in these skills
- Faculty should be aware of the different active-learning instructional methods and try to have their teaching informed by the literature

Rands, M. L.; Gansemer-Topf, A. M. The room itself is active: How classroom design impacts student engagement. *J. Learn. Spaces* 2017, *6*, 26–33.

- Audiovisual tools helped students process information, offered multiple opportunities to revisit content in different modes, and allowed for instructors to assess students understanding and for students to monitor their own learning
- Removing the spatial barrier between faculty and student space was an important classroom attribute that promoted student-faculty interaction and a place where students felt they were co-constructors of knowledge
- Lower-cost features, such as portable whiteboards and movable chairs, appeared to provide the greatest affordances for learning and student engagement
- The flexible classroom space facilitated the use of various student engagement techniques and inspired instructors and students with an array of pedagogical choices

Smith, C. V.; Cardaciotto, L. Is Active Learning Like Broccoli? Student Perceptions of Active Learning in Large Lecture Classes. *J. Scholarsh. Teach. Learn.* 2011, *11*, 53–61.

- Students in the active learning condition reported greater retention of course material for most topics as well as the course material as a whole
- Students in the active learning condition also reported greater engagement with the class material
- This is consistent with research that people are more likely to remember information that they generate themselves (when compared with information that people simply try to remember)
- Since hands-on activities are not necessarily methods that aid the process of learning, instructors should carefully choose pedagogical methods, focusing on those that promote selecting, organizing, and integrating knowledge, rather than just behavioral activity

Spence, L. D. The case against teaching. *Chang. Mag. High. Learn.* 2001, *33*, 10–19, doi:10.1080/00091380109601822.

- *Premise 1:* Teaching is a human endeavor that does not and cannot improve over time.
- *Premise 2:* Human beings are fantastic learners.
- *Premise 3:* Humans don't learn well in the teaching-focused classroom.

- *Conclusion:* We won't meet the needs for more and better higher education until professors become designers of learning experiences and not teachers.
- Expert-designed learning spaces and experiences using emerging information technologies will allow numerous students to learn on their own, driven at their own pace and guided by their own interests
- The new task for faculty is to form teams to invent and create such learning environments, inspired by the motto: *"It's not the teaching, it's the learning, stupid."*

Taylor, A. Top 10 reasons students dislike working in small groups ... and why I do it anyway. *Biochem. Mol. Biol. Educ.* 2011, *39*, 219–220, doi:10.1002/bmb.20511.

- Research supports instructor-selected groups, with the goal of forming teams of three to four students that are diverse in both academic skills and demographics
- To ensure students neither shirk their responsibilities nor dominate the discussion, specific roles such as manager, technician, reporter, and recorder should be assigned on a rotating basis and students can be given the opportunity to evaluate small group members
- As knowledge is constructed, not transferred, students not only grasp the material's complexity by struggling with it, they also learn how to learn

Weimer, M. Focus on learning, transform teaching. *Chang. Mag. High. Learn.* 2003, *35*, 48–54, doi:10.1080/00091380309604119.

- Rather than promoting new teaching techniques that may or may not lead to learning, beginning with learning can start a change process that ends with transformed teaching
- In learner-centered teaching, there are five key changes to practice:

  1. The balance of power
     - *Problem:* Faculty make too many decisions about learning for students
     - *Solution:* In responsible ways, faculty should share decision-making with students
     - *Result:* Teachers control less, but students are more involved
  2. The role of the teacher
     - *Problem:* Classroom action still features teachers
     - *Solution:* Teaching should support student agency
     - *Result:* Students build knowledge for themselves, and teachers confront the messiness of learning
  3. The responsibility for learning
     - *Problem:* Faculty "force" learning on reluctant participants
     - *Solution:* Faculty should create learning environments that motivate students to accept responsibility for learning
     - *Result:* Students grow increasingly autonomous and need teachers less
  4. Function of content
     - *Problem:* Faculty make covering content their top priority
     - *Solution:* Teachers should build their students' knowledge base and develop their learning skills and learner self-awareness
     - *Result:* Teachers cover less, but students learn more

5. The purposes and processes of evaluation
    - *Problem:* Evaluation activities are grade oriented and completed exclusively by teachers
    - *Solution:* Evaluation activities should be used to promote learning and to develop assessment skills
    - *Result:* Short term, fewer arguments over grades; long term, more successful self-monitoring of learning

3. Student Resistance to Active Learning

Brookfield, S. D. Understanding students' resistance to learning. In *The skillful teacher: On technique, trust, and responsiveness in the classroom*; Jossey-Bass, A Wiley Brand: San Francisco, CA, 2015; pp. 213–225 ISBN 978-1-118-45029-1.

- Fear of change is ground zero for resistance to learning
- But learning, by definition, involves change
- Learning requires us to explore new ideas, acquire new skills, develop new ways of understanding old experiences, and so on
- Student resistance to learning may be due to:
    - Poor self-image as learners
    - Fear of the unknown
    - Loss of a normal rhythm of learning
    - Disjunction of learning and teaching preferences
    - Apparent irrelevance of the learning activity
    - Inappropriate level of prerequisite knowledge
    - Fear of public embarrassment
    - Cultural factors, such as a feeling of abandoning "working class values"
    - Lack of clarity in teachers' instructions
    - Students' dislike of teachers
    - The teacher is moving too far, too fast

Cooper, K. M.; Ashley, M.; Brownell, S. E. Using Expectancy Value Theory as a Framework to Reduce Student Resistance to Active Learning: A Proof of Concept. *J. Microbiol. Biol. Educ.* 2017, *18*, 1–8, doi:10.1128/jmbe.v18i2.1289.

- Students appeared to be resistant to active learning because they were unfamiliar with the teaching methods, and increased exposure to active learning decreased their initial resistance
- Most of the students described their own personal positive experience with active learning as being the primary way they determined that active learning had greater value and less cost

Deslauriers, L., McCarty, L. S., Miller, K., Callaghan, K., & Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. *Proceedings of the National Academy of Sciences*, 201821936. doi:10.1073/pnas.1821936116

- First year physics students, controlled experimental design

- For novice students such as in this study, the increased cognitive effort required by active learning strategies in the classroom resulted in them feeling like they learned less
- Students' attitudes about active learning improved over the course of the semester as a result of good teaching strategies and clear communication about the purpose of the pedagogy
- Instructors should explicitly discuss the value of increased cognitive efforts associated with active learning
- Instructors should give an assessment as early as possible in the course so students can gauge their actual learning

Felder, R. M.; Brent, R. Navigating the Bumpy Road to Student-Centered Instruction. *Coll. Teach.* 1996, *44*, 43–47, doi:10.1080/87567555.1996.9933425.

- Students may not appreciate having the direct support of teachers suddenly withdrawn
- Students may not understand the known benefits of active learning strategies
- Students may feel frustrated with not being given or getting "the right answer"
- Students may not be used to, dislike, or have difficulty working in a group, especially if the burden of group work falls on a few individuals
- The resistance you encounter from some students is a natural part of their journey from dependence to intellectual autonomy

Henderson, C.; Khan, R.; Dancy, M. Will my student evaluations decrease if I adopt an active learning instructional strategy? *Am. J. Phys.* 2018, *86*, 934–942, doi:10.1119/1.5065907.

- Reasons for decreased evaluations from students when active learning instruction was implemented were attributed to students:
    1. Feeling that instructors were not teaching (43%)
    2. Disapproving of having to work hard in class (37%)
    3. Perceiving that they did not know what to expect from the class (17%)
    4. Disliking the interaction required in class (11%)
- Reasons for increased evaluations from students when active learning instruction was implemented were attributed to students:
    1. Feeling that they learned more (30%)
    2. Finding the class more enjoyable (29%)
    3. Appreciating the use of technology (24%)

Hillyard, C.; Gillespie, D.; Littig, P. University students' attitudes about learning in small groups after frequent participation. *Act. Learn. High. Educ.* 2010, *11*, 9–20, doi:10.1177/1469787409355867.

- Students may not understand that group activities support their learning
- This study and two others found that between 17 and 32% of students reported that cooperative learning positively affected their learning
- However, students did become more positive about groups enhancing their learning as they participated in more groups
- 40% of students reported that "a few dominated" in group learning situations, which indicates that management issues in program groups are problematic across courses

- If students had bad past experiences in groups, their attitudes remained negative, regardless of their experiences in the program

Hutchings, M.; Quinney, A. The Flipped Classroom, Disruptive Pedagogies, Enabling Technologies and Wicked Problems: Responding to "the Bomb in the Basement." ***Electron. J. e-Learning*** **2015,** ***13*****, 106–119, doi:10.1103/PhysRevLett.83.3585.**

- While students appear to prefer a flipped classroom approach, some can find it disconcerting at first and some remain dissatisfied with the change in the traditional approach despite the learning gains

Joseph Lobo, G. Active learning interventions and student perceptions. J. Appl. Res. High. Educ. 2017, 9, 465–473, doi:10.1108/JARHE-09-2016-0061.

- Most students appreciated the active learning strategies because they perceived that they were helping them learn
- However, students' overall evaluations did not seem to reflect an appreciation for the efforts to facilitate learning
- Specifically, students felt that the course that integrated active learning strategies did not promote commitment to the study of the material
- Although students may well be able to appreciate what is good for their learning, they may not like it
- Neither students (nor faculty) really want or have the time to give the learning process what it requires: time, effort, and exasperation

Nguyen, K. A.; Husman, J.; Borrego, M. J.; Shekhar, P.; Prince, M. J.; DeMonbrun, R. M.; Finelli, C. J.; Henderson, C.; Waters, C. K. Students' expectations, types of instruction, and instructor strategies predicting student response to active learning. ***Int. J. Eng. Educ.*** **2017,** ***33*****, 2–18, doi:10.1016/j.ijengsci.2010.03.001.**

- Assigning work to student teams can lead to learning benefits and student satisfaction, provided that the instructor pays attention to how the teams and the assignments are facilitated
- In this study, no evidence was found to support the common concern that instructor or course evaluations are negatively affected by adopting active learning strategies
- Most students saw educational value in active learning strategies, felt positively about them, and participated fully in the activities

Prince, M.; Weimer, M. Understanding student resistance to active learning. ***Faculty Focus.*** **November 2017, pp. 1–4.**

- Many empirical studies suggest that student resistance to active learning is not the dominant response to this instruction
- When resistance occurs, it will more likely involve a small fraction of the students in class and will most often involve passive resistance rather than more confrontational behaviors
- Some reasons students resist active learning approaches are legitimate, for example:

    - Active learning requires more work from students
    - Active learning makes students more responsible for learning
    - A lot of group work being used in college courses is not well designed and consequently students had unsuccessful learning experiences in groups
    - Students who had bad learning experiences naturally resist what they perceive to be similar learning activities

Seidel, S. B.; Tanner, K. D. "What if students revolt?"-Considering student resistance: Origins, options, and opportunities for investigation. *CBE Life Sci. Educ*. 2013, *12*, 586–595, doi:10.1187/cbe-13-09-0190.

- Student resistance is either constructive or destructive student behavior that is in opposition to the instructor
- Destructive student resistance involves behaviors that limit the learning of the students themselves and potentially other students around them
- Student resistance may emerge from poor interactions between individual students and their classroom peers as a result of the increased classroom collaboration
- A common example of poor student-student interaction in the classroom is when individuals working in a group do not participate equitably
- Perceived unfairness of workload distribution within a group can have a strong negative impact on student attitudes toward teamwork
- Similar to instructor barriers to implementing active learning strategies, students may experience challenges such as lack of training, lack of time, lack of incentives, and tensions related to identity shifts (i.e., what it means to be a student in a classroom)
- In this regard, *student barriers* to engaging in active-learning approaches may be a more appropriate to term than "student resistance" to better empathize with the challenges student face in our classrooms

Shekhar, P., Demonbrun, M., Borrego, M., Finelli, C., Prince, M., Henderson, C., & Waters, C. Development of an Observation Protocol to Study Undergraduate Engineering Student Resistance to Active Learning. *Int. J. Eng. Educ.* 2015, *31*, 597–609.

- Students may resist the use of active learning methods because these methods tend to:
    - Require more work on the part of the student
    - Cause anxiety about students' ability to succeed in a new environment
    - Set expectations that students are not yet prepared to meet
- There are three basic levels of student resistance:
    1. Passive, non-verbal
    2. Partial compliance
    3. Open resistance
- Several factors influence the level of student engagement:
    1. Class size
    2. Instructor involvement
    3. Type of active learning

Smith, C. V.; Cardaciotto, L. Is Active Learning Like Broccoli? Student Perceptions of Active Learning in Large Lecture Classes. *J. Scholarsh. Teach. Learn.* 2011, *11*, 53–61.

- Despite reporting greater retention of course material and engagement, students in the active learning condition did not report more positive attitudes about the class
- Active learning may indeed be like broccoli: Although it is good for students intellectually, their overall impression of it may not be completely positive

Taylor, A. Top 10 reasons students dislike working in small groups … and why I do it anyway. *Biochem. Mol. Biol. Educ.* 2011, *39*, 219–220, doi:10.1002/bmb.20511.

- Reasons students dislike small group exercises:
    1. It is hard to focus during small group exercises
    2. We are always rushed
    3. Puts the work on us instead of on you
    4. It is over the same material I didn't understand in the reading
    5. We can form study groups outside of class on our own; we would rather hear someone who understands the material explain it
    6. We are all confused, so getting in groups merely compounds the confusion
    7. I don't like the people in my small group
    8. Where is Morgan? Where is Chris? (Names changed to protect the guilty)
    9. We would cover more material if you lectured
    10. I cannot sleep during a small group exercise
- Students concerns about small group exercises can be categorized into three main areas:
    1. Group dynamics
    2. Learning process
    3. Preparation and participation
- In a way, what they dislike shows that working in small groups is doing exactly what it is supposed to: Teaching students to cooperate, communicate, delegate, and trust each other

Van Sickle, J. Discrepancies between Student Perception and Achievement of Learning Outcomes in a Flipped Classroom. *J. Scholarsh. Teach. Learn.* 2016, *16*, 29–38, doi:10.14434/josotl.v16i2.19216.

- While students in the traditional classes thought they learned more, the students in the flipped classes actually demonstrated increased achievement of student outcomes
- Possible reasons for discrepancy between student learning outcomes and evaluations:
    - During a traditional, lecture-based course, students are able to follow along with the instructor's thinking, and they perceive that they are understanding; however, during a flipped class, class time is devoted to working problems, and students remember the difficulty they had during class working problems

- Students may have difficulty evaluating their learning directly following a flipped class if it is a new experience for them
- In a flipped class, students who do not prepare outside of class using provided materials will likely struggle significantly throughout the class session, which may lead to students feeling worse about the class
- Reduced, unequal, or fluctuating teacher-student interaction may lead to negative perceptions about the class
- Learner-centered instruction requires students to take risks that are not required of them in lecture-based instruction (such as proposing ideas or trying things that may be wrong), which can lead to negative perceptions about the course

Weimer, M. Responding to resistance. In *Learner-centered teaching: Five key changes to practice*; Jossey-Bass, a Wiley imprint: San Francisco, CA, 2013; pp. 199–217.

- Student response to learner-centered approaches involves resistance based on four reasons:
  1. Learner-centered approaches require more work
     - Learner-centered approaches engage students and get them working on learning tasks
  2. Learner-centered approaches are threatening
     - The student's fear is that they won't be able to deliver what they're being asked to do
  3. Learner-centered approaches involve losses
     - Students may understand intellectually that the new approaches foster their personal development, but the feeling of loss is an emotional one that sometimes manifests itself as resistance
  4. Some students are not ready for learner-centered approaches
     - Students are accustomed to being dependent learners, so resistance may be due to a legitimate objection to something the student is not yet prepared to handle
- Student resistance to learner-centered approaches can manifest as:
  1. Passive, nonverbal resistance
     - Student exhibits an overwhelming lack of enthusiasm
  2. Partial compliance
     - Can be exhibited in many ways, such as the student partially participating or fulfilling duties
  3. Open resistance
     - Student blatantly objects to learner-centered approaches

4. Relationship Between Student Resilience and Active Learning

Beri, N.; Kumar, D. Predictors of Academic Resilience Among Students: A Meta Analysis. *i-manager's J. Educ. Psychol.* 2018, *11*, 37–44, doi:10.26634/jpsy.11.4.14220.

- Academic resilience has numerous components, including confidence level, motivation, and ability to understand and manage stress while facing adverse conditions
- There is strong evidence connecting resilience and academic success
- Family, peer groups, community, and school support are among numerous predictor variables for academic resilience
- Therefore, policymakers, administrators, teachers, and parents should work on strategies to enhance academic resilience
- Constructive learning environments that promote resilience can result in greater academic success for students

Cassidy, S. Resilience building in students: The role of academic self-efficacy. *Front. Psychol.* 2015, *6*, 1–14, doi:10.3389/fpsyg.2015.01781.

- Self-efficacy relates to an individual's perception of their capabilities and is commonly reported as associated with better academic performance
- Perceived self-efficacy has been shown to be a better predictor of academic performance than previous achievement or ability and seems particularly important when individuals face adversity
- Self-efficacy beliefs are associated with increased motivation and perseverance and resistance to negative thought
- Having positive self-efficacy beliefs is likely to contribute toward increased academic resilience in students, where academic resilience is defined as students' cognitive- affective and behavioral responses to academic adversity
- Students advocate more positive adaptive responses for peers experiencing adversity
- This suggests that students, including those with lower self-efficacy, are likely to be a positive source of encouragement and resilience for peers who are experiencing challenge and adversity
- Therefore, peer-assisted learning activities, which have been shown to promote learning, also benefit and encourage student academic resilience
- The fact that students advocate greater resilience for their peers also means that they are aware of what are and are not adaptive responses and have the potential to exhibit greater personal resilience than they may be currently exhibiting
- Students could thus be encouraged to reflect on their own reasons for advocating greater resilience for their peers and to explore the potential to move toward greater personal adoption of the responses advocated for their peers
- Additionally, self-efficacy training, already shown to be effective in an educational context, offers another approach to building academic resilience in students
- No significant differences in academic resilience according to age, gender, or year of study were observed in the study, which is consistent with previous studies

Chung, E.; Turnbull, D.; Chur-Hansen, A. Differences in resilience between 'traditional' and 'non-traditional' university students. *Act. Learn. High. Educ.* 2017, *18*, 77–87, doi:10.1177/1469787417693493.

- Life experiences commonly affiliated with being a mature-aged student, including work and being a career, may contribute to higher resilience, which is related to a students' well-being and academic success

Edwards, T., Catling, J.C., & Parry, E. Identifying predictors of resilience in students. *Psychol. Teach. Rev.* 2016, *22*, 26–34.

- Locus of control is an aspect of personality that has been shown to affect the way individuals perceive adversity
- Individuals with an internal locus of control are likely to perceive events as being contingent on one's own behavior and/or characteristics, implying that they perceive themselves to be in control of the events that happen to them; while those with an external locus of control perceive events that befall them to be the result of environmental factors such as luck, fate or chance
- Individuals generally perceive situations which they have no control over as more aversive than those where they perceive some degree of control
- Lack of adversity within the relationship with parents/guardians and an internal locus of control predicted higher levels of resilience in young people
- Internal locus of control can act as a protective factor promoting resilient outcomes in the presence of adversity
- Individuals with an external locus of control who are exposed to adversity are evidently at increased risk of the negative outcomes associated with these adverse experiences
- Strategies to promote resilience in students should focus on establishing and/or improving protective factors, such as relationships with peers and the level of perceived control over adverse experiences
- Such interventions could be given in the form of individual or family therapy, focusing specifically on establishing and/or improving the protective factors that are lacking

Hillyard, C.; Gillespie, D.; Littig, P. University students' attitudes about learning in small groups after frequent participation. *Act. Learn. High. Educ.* 2010, *11*, 9–20, doi:10.1177/1469787409355867.

- If students had bad past experiences in groups, their attitudes remained negative, regardless of their experiences in the program
- Experience alone will not always create more positive attitudes about learning in groups

Kotzé, M.; Niemann, R. Psychological resources as predictors of academic performance of first-year students in higher education. *Acta Acad.* 2013, *45*, 85–121.

- Academic performance starts with focusing on a desired goal and the thoughts about how one is going to produce the pathways to secure the desired goal
- These pathways provide the student with a mental plan of action that is focused on overcoming potential obstacles that may interfere with achieving academic success, while courageously facing any adversity they may encounter

- Hope and resilience were positive predictors of academic performance, while optimism was not related to academic performance
- Although optimism may reinforce the pathways and the focus on specific goals, the generation of the pathways—through hope and resilience—is the key to attaining the goal of academic success

Waxman, H. C.; Gray, J. P.; Padron, Y. N. *Review of Research on Educational Resilience*; Berkeley, CA, 2003.

- Resilient students are those who succeed in school despite the presence of adverse conditions
- Compared to non-resilient students, resilient students perceive a more positive learning environment and are more satisfied with their classrooms
- Non-resilient students often indicate that they have more difficulty in their classwork than resilient students, and they are also engaged less in their schoolwork
- Non-resilient students need help to become more engaged and control their attention
- Instructional activities that involve students in challenging lessons while providing them with appropriate skills, relevant feedback, and clear goals would help them develop new skills and learn to focus their attention (e.g., cognitively-guided instruction, culturally responsive teaching, technology-enriched instruction, cooperative learning, and instructional conversations)
- Resiliency is fostered when teachers provide meaningful opportunities for students to contribute their skills and energies
- Teachers should provide opportunities to participate and contribute by allowing students to express their (constructive) opinions, make choices, problem-solve, work with and help others, and "give back" to their community
- Students should be treated as responsible individuals (i.e., for their own learning) and afforded some amount of control in their classroom experience
- These research-based, instructional practices all stress a student-centered model of classroom instruction that emphasizes more active student learning, with teachers acting as facilitators of learning
- The school environment is a critical arena for promoting the development of protective factors associated with individual resilience
- Quality teacher professional development is one of the keys to successful school reform and improving the education of students at risk of failure, and feedback from classroom observation and survey data can be a catalyst for this process

5. Strategies for Overcoming Student Resistance to Active Learning

Brookfield, S. D. Responding to students' resistance to learning. In *The skillful teacher: On technique, trust, and responsiveness in the classroom*; Jossey-Bass, A Wiley Brand: San Francisco, CA, 2015; pp. 227–238 ISBN 978-1-118-45029-1.

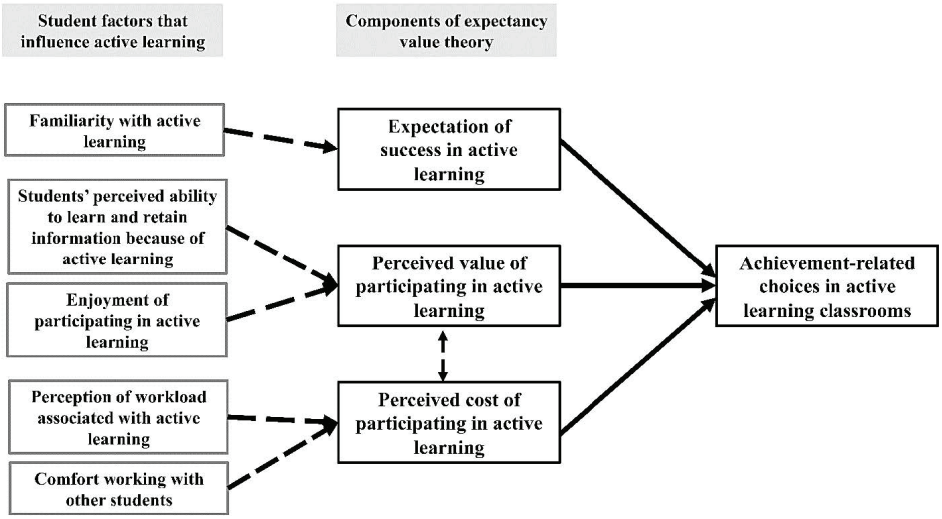
- Tips for responding to student resistance include:

- Try to sort out the cause of the resistance
- Ask yourself of the resistance is justified
- Know your students' backgrounds, particularly their level of prior knowledge
- Involve former student resisters who can encourage new students
- Model appropriate and positive behaviors
- Involve students in educational planning when appropriate
- Use a variety of teaching methods and approaches
- Assess student learning incrementally and respond accordingly
- Communicate your intentions and assess whether they are clearly understood
- Build a case for learning, stressing the value and benefits of chosen learning activities
- Create situations and experiences in which students can succeed
- Don't push too far, too fast
- Acknowledge that resistance is a normal response to new or challenging learning experiences
- Try to limit the negative effects of resistance by modifying your specific approach when necessary, but avoid sacrificing the learning experiences you have designed

Brookfield, S. D. Understanding students' resistance to learning. In *The skillful teacher: On technique, trust, and responsiveness in the classroom*; Jossey-Bass, A Wiley Brand: San Francisco, CA, 2015; pp. 213–225 ISBN 978-1-118-45029-1.

- As teachers, we may have blind spots as to why students resist learning because we often love what we are teaching
- Reflection on our own experiences with learning can help us understand better how to respond to students who steadfastly refuse to learn
- We should not become obsessed with converting a small and easily identifiable minority of openly resistant students into becoming enthusiastic advocates for learning

Cooper, K. M.; Ashley, M.; Brownell, S. E. Using Expectancy Value Theory as a Framework to Reduce Student Resistance to Active Learning: A Proof of Concept. *J. Microbiol. Biol. Educ.* 2017, *18*, 1–8, doi:10.1128/jmbe.v18i2.1289.



- Students need to perceive value stemming from active learning, as well as have confidence that they can accomplish active learning activities
- Students also need to perceive low costs to participating in order to maximize their active learning experiences
- Self-reflection about active learning may be important for a student to ascribe value to active learning

Felder, R. M.; Brent, R. Navigating the Bumpy Road to Student-Centered Instruction. *Coll. Teach.* 1996, *44*, 43–47, doi:10.1080/87567555.1996.9933425.

- The benefits of active learning strategies are neither immediate nor automatic
- The key is to provide enough structure and guidance to help students perform satisfactorily and accept responsibility for their own learning
- Strategies for overcoming student resistance to active learning include:
    1. Create graphic organizers, prepare study guides summarizing critical questions answered by the readings, and/or give brief or extended writing assignments to ease students' transition from relying on you to provide all needed information to relying on themselves
    2. Provide constructive feedback during and after active learning exercises, as well as examples of the products you are looking to help students reach active learning goals
    3. Use explanations that reassure students you are not performing an experiment, but teaching in a way known to help students learn more and understand better
    4. Include provisions that assure individual accountability in cooperative learning exercises, such as having team members formulate and write out a set of team standards and expectations which is periodically evaluated; additionally, it is best to assign groups to ensure diversity

Finelli, C. J.; Nguyen, K.; Demonbrun, M.; Borrego, M.; Prince, M.; Husman, J.; Henderson, C.; Shekhar, P.; Waters, C. K. Reducing Student Resistance to Active Learning: Strategies for Instructors. *J. Coll. Sci. Teach.* 2018, *47*, 80–91, doi:10.1093/molbev/msg067.

- The use of explanation and facilitation strategies to reduce student resistance to active learning resulted in significantly greater student participation, less distraction, and higher overall evaluation of both the instructor and the course
- Facilitation strategies to reduce student resistance to active learning may be more important than explanation strategies
- The value that students found in the active learning was an even stronger predictor than the use of explanation and facilitation strategies of greater student participation, less distraction, and higher overall evaluation of both the instructor and the course
- There was a relatively high correlation between explanation, facilitation, and value

Hillyard, C.; Gillespie, D.; Littig, P. University students' attitudes about learning in small groups after frequent participation. *Act. Learn. High. Educ.* 2010, *11*, 9–20, doi:10.1177/1469787409355867.

- Instructor clarity in explaining why particular group activities were used was more important than how they structured or composed groups, even for students who were experienced with group activities

- If students had bad past experiences in groups, their attitudes remained negative, regardless of their experiences in the program
- Instructors need to address negative attitudes that students bring with them about bad past group experiences

Mohamed, A.-R. Effects of Active Learning Variants on Student Performance and Learning Perceptions. *Int. J. Scholarsh. Teach. Learn.* 2008, *2*, 1–15, doi:10.20429/ijsotl.2008.020211.

- Student resistance to active learning formats can be overcome if students perceive the new format helps them learn in ways that traditional lectures fail to do
- Instructors need to be explicit in this regard and guide students through the benefits of the new methods
- Short-burst lecturing followed by active learning exercises and group work was effective in helping students to accept the active learning formats
- Students who associated positive value in engaging in active learning were more willing to accept the new formats
- The use of milder active learning formats did not lessen student resistance to more complex and stricter formats
- Students are willing to change roles from passive listeners to active learners by taking responsibility for their own learning when the right environment and classroom dynamics are created for them

Nguyen, K. A.; Husman, J.; Borrego, M. J.; Shekhar, P.; Prince, M. J.; DeMonbrun, R. M.; Finelli, C. J.; Henderson, C.; Waters, C. K. Students' expectations, types of instruction, and instructor strategies predicting student response to active learning. *Int. J. Eng. Educ.* 2017, *33*, 2–18, doi:10.1016/j.ijengsci.2010.03.001.

- Assigning work to student teams can lead to learning benefits and student satisfaction, provided that the instructor pays attention to how the teams and the assignments are facilitated
- In this study, no evidence was found to support the common concern that instructor or course evaluations are negatively affected by adopting active learning strategies
- Most students saw educational value in active learning strategies, felt positively about them, and participated fully in the activities
- The way instructors explain and facilitate active learning instruction influences student reactions
- When using active learning, instructors should choose activities of appropriate difficulty, clearly explain what students are expected to do during the activity, and clarify the benefit of the activity for students
- Additionally, instructors should facilitate activities by providing appropriate time for them and by encouraging student engagement through their demeanor and interactions with the class

Owens, D. C.; Sadler, T. D.; Barlow, A. T.; Smith-Walters, C. Student Motivation from and Resistance to Active Learning Rooted in Essential Science Practices. *Res. Sci. Educ.* 2017, 1–25, doi:10.1007/s11165-017-9688-1.

- Instructors need to provide consistent feedback to reduce the frustration that might accompany engagement in science practices that are challenging or unfamiliar

- In-class active-learning instruction should be accompanied by additional resources that enable students to deepen their conceptual understanding outside of class
- Teachers should ensure that expectations are clear so that students understand what success looks like in terms of participation in active learning and on assessments that determine grades
- Clarity up front concerning the instructor's perception of valuable instruction and the provision of a forum for students to indicate their preferred mechanism of learning can also serve to abate resistance to active learning

Prince, M.; Weimer, M. Understanding student resistance to active learning. *Faculty Focus.* November 2017, pp. 1–4.

- When teachers understand what might be causing resistance to active learning, it clarifies the best ways to respond
- In general, teachers should respond:
    - without blame
    - with open communication
    - positively
    - by transforming the resistance into teachable moments

Seidel, S. B.; Tanner, K. D. "What if students revolt?"-Considering student resistance: Origins, options, and opportunities for investigation. *CBE Life Sci. Educ.* 2013, *12*, 586–595, doi:10.1187/cbe-13-09-0190.

- Strategies to reduce student resistance include:
    - Reframing your understanding of "student resistance" to a more empathetic view of the challenges that students face in our classrooms (for example, *student barriers* to engaging in active-learning approaches)
    - Explaining the purpose and benefit of your pedagogical choices on the first day of the course and throughout the duration of the course
    - Maximizing positive student interactions in highly collaborative classrooms and reducing incidents of unequal group participation by decreasing group size, decreasing project scope, and providing mechanisms for peer evaluation (i.e., facilitate)
    - Using verbal and non-verbal behaviors (such as knowing students' names, smiling, and making eye contact) that are observed by students and influence their perceptions of their relationship with their instructor (this is also an aspect of active learning facilitation)
    - Using scoring rubrics—explicit criteria about how an instructor will be evaluating student work—to reduce students' perceptions of unfair grading
    - Providing a forum for students to (constructively) express what is effectively supporting their learning, as well as what is not

Shekhar, P., Demonbrun, M., Borrego, M., Finelli, C., Prince, M., Henderson, C., & Waters, C. Development of an Observation Protocol to Study Undergraduate Engineering Student Resistance to Active Learning. *Int. J. Eng. Educ.* 2015, *31*, 597–609.

- Strategies to reduce student resistance and increase engagement include:
    - Encouraging passive students through non-confrontational approaches
    - Introduction of the activity by explaining its purpose
    - The use of a variety of active learning techniques

Silverthorn, D. U. Teaching and learning in the interactive classroom. *Adv. Physiol. Educ.* 2006, *30*, 135–140, doi:10.1152/advan.00087.2006.

- Tips for success in implementing interactive classrooms and active learning methods:
    - Define your goals and objectives
    - Start small and don't change too many things at once
    - Tell your students what you're doing and why, and keep telling them
    - Provide students with tools to help them change
    - Match the assessment to your teaching style, goals, and objectives
    - Have the right attitude

Taylor, A. Top 10 reasons students dislike working in small groups ... and why I do it anyway. *Biochem. Mol. Biol. Educ.* 2011, *39*, 219–220, doi:10.1002/bmb.20511.

- Students concerns about small group exercises can be categorized into three main areas: Group dynamics, learning process, and preparation and participation
- To ensure students neither shirk their responsibilities nor dominate the discussion, specific roles such as manager, technician, reporter, and recorder should be assigned on a rotating basis and students can be given the opportunity to evaluate small group members
- Providing explanations for the mode of learning, acknowledging that it is hard work, assisting with time management, and praising both effort and accomplishment are ways that we can help students to cope with active learning strategies

Tharayil, S.; Borrego, M.; Prince, M.; Nguyen, K. A.; Shekhar, P.; Finelli, C. J.; Waters, C. Strategies to mitigate student resistance to active learning. *Int. J. STEM Educ.* 2018, *5*, 1–16, doi:10.1186/s40594-018-0102-y.

- Students' recollection of their instructors' use of explanation and facilitation strategies correlate with increased participation, lower levels of distraction, and more positive course evaluations
- *Explanation strategies:* Explaining course expectations, the purpose of the activity, and activity expectations
- *Facilitation strategies:* Walking around the room, assuming an encouraging demeanor, inviting student questions, soliciting student feedback, approaching non-participating students, developing a routine, grading on participation, conscientiously designing activities for student participation, and using incremental activities
- There are many possible ways for instructors to encourage participation, reduce distraction and potentially increase evaluation scores while being consistent with their beliefs and preferences
- Instructors should be reflective in deciding which strategies would best fit their intended instructional goals and classroom scenarios and why

Weimer, M. Responding to resistance. In *Learner-centered teaching: Five key changes to practice*; Jossey-Bass, a Wiley imprint: San Francisco, CA, 2013; pp. 199–217.

- The best way to respond to resistance is with communication—a free and open exchange between and among everybody involved, which includes:
  1. Communicate frequently and explicitly about the rationale for learner
     - Learner-centered teachers explain the educational rationale behind what they are asking students to do
  2. Communicate messages that encourage and positively reinforce
     - To convince students and help them overcome the resistance they feel, teacher encouragement needs to rest on a firm and absolute belief in students' abilities to learn, to figure things out, and to develop into mature, autonomous learners
  3. Solicit student feedback on their learning experiences regularly
     - Resistance is overcome when students are given opportunities to talk about it
  4. Resist their resistance
     - Resistance diminishes when you resist it and soften your firm response with the proposed communication strategies

Welsh, A. J. Exploring Undergraduates' Perceptions of the Use of Active Learning Techniques in Science Lectures. *J. Coll. Sci. Teach.* 2012, *42*, 80–87.

- Student recommendations for clicker or group discussion questions or activities:
  - Should push students to work with one another
  - Should be challenging and relevant to the course material
  - Should add value to and be integrated well within the lecture material

6. Resilience and Resistance to Active Learning: A Whole-System View

Benoit, A. Monitoring Implementation of Active Learning Classrooms at Lethbridge College, 2014-2015. *J. Learn. Spaces* 2017, *6*, 14–25.

- Classrooms are often not optimized for active learning instruction
- Although close proximity and seating orientation at round tables enhances student collaboration, this is not always desirable (e.g., during summative assessments)

Beri, N.; Kumar, D. Predictors of Academic Resilience Among Students: A Meta Analysis. *i-manager's J. Educ. Psychol.* 2018, *11*, 37–44, doi:10.26634/jpsy.11.4.14220.

- Academic resilience has numerous components, including confidence level, motivation, and ability to understand and manage stress while facing adverse conditions
- There is strong evidence connecting resilience and academic success
- Family, peer groups, community, and school support are among numerous predictor variables for academic resilience

- Therefore, policymakers, administrators, teachers, and parents should work on strategies to enhance academic resilience
- Constructive learning environments that promote resilience can result in greater academic success for students

Cassidy, S. Resilience building in students: The role of academic self-efficacy. *Front. Psychol.* 2015, *6*, 1–14, doi:10.3389/fpsyg.2015.01781.

- Self-efficacy relates to an individual's perception of their capabilities and is commonly reported as associated with better academic performance
- Having positive self-efficacy beliefs is likely to contribute toward increased academic resilience in students, where academic resilience is defined as students' cognitive- affective and behavioral responses to academic adversity
- Self-efficacy training, already shown to be effective in an educational context, offers another approach to building academic resilience in students
- No significant differences in academic resilience according to age, gender, or year of study were observed in the study, which is consistent with previous studies

Dyer, J. O.; Elsenpeter, R. L. Utilizing quantitative analyses of active learning assignments to assess learning and retention in a general biology course. *Bioscene* 2018, *44*, 3–12.

- Active learning assignments should be assessed to ensure that we are utilizing tools that will continue to improve student learning, retention, and positive experiences in the classroom

Edwards, T., Catling, J.C., & Parry, E. Identifying predictors of resilience in students. *Psychol. Teach. Rev.* 2016, *22*, 26–34.

- Strategies to promote resilience in students should focus on establishing and/or improving protective factors, such as relationships with peers and the level of perceived control over adverse experiences
- Such interventions could be given in the form of individual or family therapy, focusing specifically on establishing and/or improving the protective factors that are lacking

Felder, R. M.; Brent, R. Navigating the Bumpy Road to Student-Centered Instruction. *Coll. Teach.* 1996, *44*, 43–47, doi:10.1080/87567555.1996.9933425.

- Instructor concerns about implementing active learning strategies include:
    1. Not covering the course content
    2. Losing control of the class
    3. Student resentment for being held responsible for their own learning
    4. Student frustration and a lack of understanding of active learning exercise goals
    5. Student resistance to group work and activities
    6. Lack of student learning as a result of group work or activities

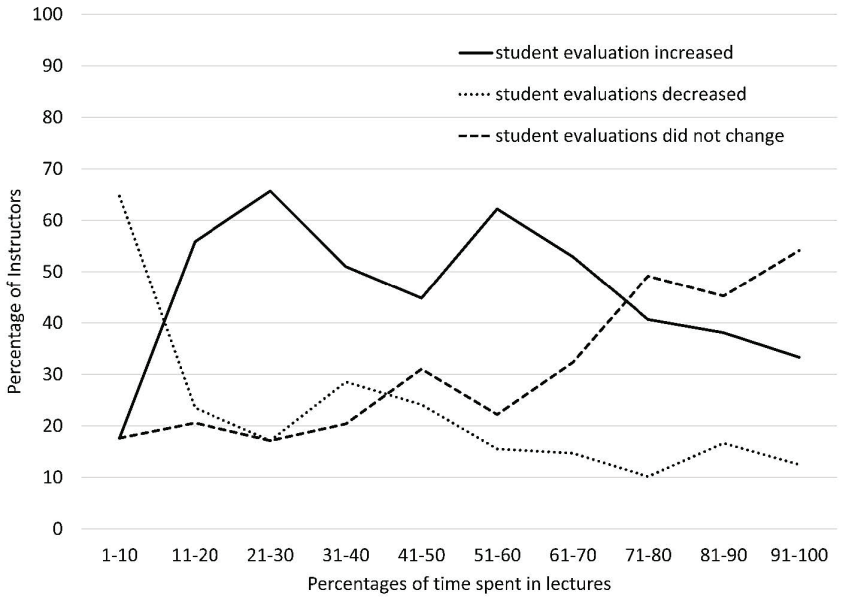
- Rebuttals to instructors:
    1. Put a substantial portion of course notes in handouts or online, leaving gaps in the classroom time period to be filled in with active learning exercises
    2. As the teacher, you pose the problems, set time limits, provide as much or as little guidance as you wish, ask questions, select students to respond, give positive responses, and cut off discussion—so there's no question who's in control
    3. Advice regarding instructor concerns 3–6 are in Section 5. Strategies for Overcoming Student Resistance to Active Learning
- Instructors who move into student-centered instruction gradually rather than trying to do it all at once, who are prepared for initially negative student reactions, and who have the patience and confidence to persevere will reap their rewards in having students who learn more deeply and who have better attitudes toward their subjects and themselves

Finelli, C. J.; Nguyen, K.; Demonbrun, M.; Borrego, M.; Prince, M.; Husman, J.; Henderson, C.; Shekhar, P.; Waters, C. K. Reducing Student Resistance to Active Learning: Strategies for Instructors. *J. Coll. Sci. Teach.* 2018, *47*, 80–91, doi:10.1093/molbev/msg067.

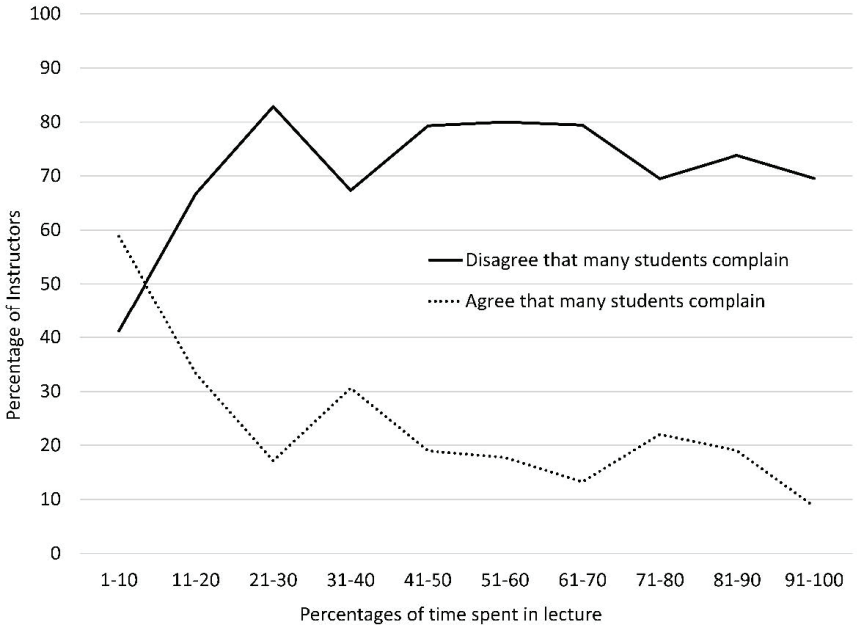
- Instructor concerns about implementing active learning include:
    1. Student resistance
    2. Efficacy of the techniques
    3. Preparation time
    4. Ability to cover the syllabus
- Notably, levels of student resistance to active learning was relatively low, which may help lower the barrier to adoption of active learning by instructors

Henderson, C.; Khan, R.; Dancy, M. Will my student evaluations decrease if I adopt an active learning instructional strategy? *Am. J. Phys.* 2018, *86*, 934–942, doi:10.1119/1.5065907.

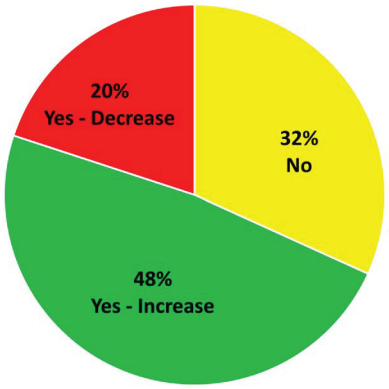
- Instructor concerns about implementing active learning strategies include:
    1. Efficacy of active learning instruction
    2. Amount of time it would take to learn about active learning and to redesign a course
    3. Amount of ongoing preparation required
    4. Ability to cover necessary course content
    5. Student resistance to active learning
- Substantial reliance on student evaluations by institutions to evaluate instructors leads to increased instructor resistance to active learning due to a perceived or actual possibility of decreased student evaluations



- Decreasing student evaluations become more likely when the percentage of class time spent in lecture drops below 20%



- Student complaints become more likely when the percentage of class time spent in lecture drops below 20%



Overall instructor perception of change in student evaluations resulting from the use of active learning (No = no change)

- Increases in student evaluations were the most common outcome reported by instructors when time spent in lectures in the active learning class was between 20 and 60 percent of the total class time
- As the time spent lecturing increased above 60%, there were more reports of no changes in student evaluations
- As the time spent lecturing dropped below 20%, there was a greater likelihood of decreasing evaluations
- Nonetheless, student evaluations should not be as heavily relied on by institutions because:
    1. They are a poor proxy for the quality of instruction (there is no clear correlation between student evaluations and student learning)
    2. They are influenced by personal characteristics of the instructor

Hillyard, C.; Gillespie, D.; Littig, P. University students' attitudes about learning in small groups after frequent participation. *Act. Learn. High. Educ.* 2010, *11*, 9–20, doi:10.1177/1469787409355867.

- If students had bad past experiences in groups, their attitudes remained negative, regardless of their experiences in the program
- Cross-institutional, campus, and departmental conversations might lead to collective approaches that would increase learning in small groups, including addressing negative past experiences that students have with group activities

Hutchings, M.; Quinney, A. The Flipped Classroom, Disruptive Pedagogies, Enabling Technologies and Wicked Problems: Responding to "the Bomb in the Basement." *Electron. J. e-Learning* 2015, *13*, 106–119, doi:10.1103/PhysRevLett.83.3585.

- Although student learning gains from active learning instruction may not always translate into improved performance in assessment, they may promote lifelong learning

McConnell, D. A.; Chapman, L.; Czaijka, C. D.; Jones, J. P.; Ryker, K. D.; Wiggen, J. Instructional Utility and Learning Efficacy of Common Active Learning Strategies. *J. Geosci. Educ.* 2017, *65*, 604–625, doi:10.5408/17-249.1.

- A student's experience in college-level introductory courses represents a critical tipping point for persistence in science, technology, engineering, and mathematics (STEM) fields

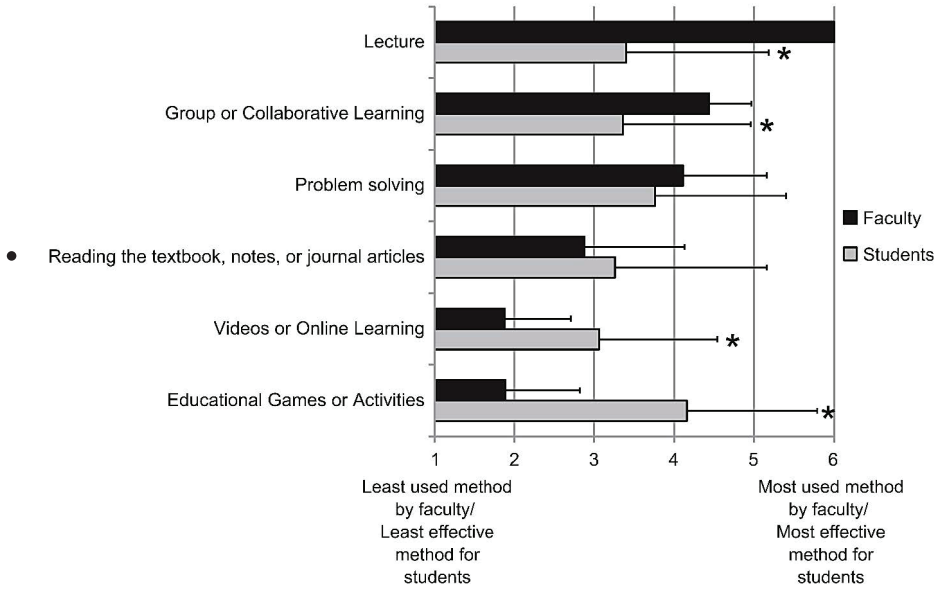
- A substantial barrier to instructors implementing active learning strategies is the time needed to develop materials and/or learn about effective teaching activities
- Even the most committed instructor would have to dedicate substantial effort over multiple semesters to find examples of suitable teaching activities, assess their utility for given courses, and redesign relevant lessons

Michael, J. Faculty Perceptions About Barriers to Active Learning. *Coll. Teach.* 2007, *55*, 42–47, doi:10.3200/CTCH.55.2.42-47.

- Instructor concerns about implementing active learning strategies include:
    1. How will I covert all the necessary content?
    2. I will have to abandon everything I have learned to do over the years
    3. Students resist non-lecture environments
    4. My course evaluations will go down
    5. My colleagues will criticize me
    6. It is scary
    7. It is just too hard!
- Teaching must be treated like a truly scholarly activity, in which teachers start to talk about teaching with their department or institutional colleagues, other members of their disciplines, and educators
- Teachers must make it their responsibility to become familiar with the scholarly literature on teaching; they must learn what others have discovered about teaching the discipline, and they must share their own teaching experiences and insights by publishing in the open literature

Miller, C. J.; Metz, M. J. A comparison of professional-level faculty and student perceptions of active learning: its current use, effectiveness, and barriers. *AJP Adv. Physiol. Educ.* 2014, *38*, 246–252, doi:10.1093/oxfordjournals.aje.a113643.

- Even when administration is supportive of alternative teaching strategies, faculty members continue to rely primarily on lecture as an instructional technique
- Some instructors who were interested in active learning failed to use active learning modules even when they were provided for free and professional development was available



- Faculty members and students appear to agree that active learning strategies are beneficial to student success
- On average, faculty members felt that 29% of face-to-face class time should be used for active learning and students believed that 40% of class time should be dedicated to active learning
- 78% of the faculty members surveyed indicated that they would be interested in learning more about the use of active learning in the classroom
- Perceived barriers to active learning by faculty were:
    1. A lack of necessary class time
    2. A high comfort level with traditional lectures
    3. Insufficient time to develop materials

Owens, D. C.; Sadler, T. D.; Barlow, A. T.; Smith-Walters, C. Student Motivation from and Resistance to Active Learning Rooted in Essential Science Practices. *Res. Sci. Educ.* 2017, 1–25, doi:10.1007/s11165-017-9688-1.

- Faculty indicate that students censure them on evaluations after incorporating active learning in their classrooms
- Published sources of anecdotal evidence abound suggesting that students resist active learning
- Students were more resistant to the increased effort of active learning instruction than to active learning itself

Tharayil, S.; Borrego, M.; Prince, M.; Nguyen, K. A.; Shekhar, P.; Finelli, C. J.; Waters, C. Strategies to mitigate student resistance to active learning. *Int. J. STEM Educ.* 2018, *5*, 1–16, doi:10.1186/s40594-018-0102-y.

- There are many possible ways for instructors to encourage participation, reduce distraction and potentially increase evaluation scores while being consistent with their beliefs and preferences
- Instructors should be reflective in deciding which strategies would best fit their intended instructional goals and classroom scenarios and why

Uttl, B.; White, C. A.; Gonzalez, D. W. Meta-analysis of faculty's teaching effectiveness: Student evaluation of teaching ratings and student learning are not related. *Stud. Educ. Eval.* 2017, *54*, 22–42, doi:10.1016/j.stueduc.2016.08.007.

- This study reanalyzes previous meta-analyses because they were found to be inaccurate due to small sample sizes and publication bias
- No relationship was found between student evaluation of teaching ratings and student achievement/learning
- Therefore, the authors' suggest that institutions focused on student learning and career success may want to abandon student evaluation of teaching ratings as a measure of faculty's teaching effectiveness

Van Sickle, J. Discrepancies between Student Perception and Achievement of Learning Outcomes in a Flipped Classroom. *J. Scholarsh. Teach. Learn.* 2016, *16*, 29–38, doi:10.14434/josotl.v16i2.19216.

- Students do not appear to be accurately evaluating their learning in flipped versus traditional classes
- While students in the traditional classes thought they learned more, the students in the flipped classes actually demonstrated increased achievement of student outcomes
- Flipped learning had the largest negative impact on students' perceptions of whether the instructor encouraged their interest in the course
- If faculty, department chairs, and those who make rank and tenure decisions understand that student perception may be poorer for learner-centered instruction than it is for lecture-based instruction, they can bear it in mind, and faculty will not be penalized for it

Waxman, H. C.; Gray, J. P.; Padron, Y. N. *Review of Research on Educational Resilience*; Berkeley, CA, 2003.

- The school environment is a critical arena for promoting the development of protective factors associated with individual resilience
- Quality teacher professional development is one of the keys to successful school reform and improving the education of students at risk of failure, and feedback from classroom observation and survey data can be a catalyst for this process

Weimer, M. Responding to resistance. In *Learner-centered teaching: Five key changes to practice*; Jossey-Bass, a Wiley imprint: San Francisco, CA, 2013; pp. 199–217.

- Faculty resist learner-centered teaching because it:
    - deals with issues of power and authority
    - takes away exclusive reliance on content expertise
    - moves teachers into the unfamiliar domain of learning skills instruction
    - raises questions about widely used instructional practices
    - requires a certain "readiness" that the teacher may not have
    - potentially diminishes the amount of content in courses
    - potentially allows students to set course policies
    - devotes class time to learning skills development
    - decreases the number of rules and requirements
    - it gives students a role in self- and peer-assessment activities

- Responding to the resistance of colleagues begins with being prepared-knowing something about the theoretical, empirical, and experiential knowledge bases on which these ideas about teaching and learning rest
    - Additional strategies to respond to the resistance of colleagues include:
        - Be mindful of the politics
        - Don't try to convert the masses
        - Use the autonomy of your classroom
        - Document the impact of your approaches
        - Find like-minded colleagues

Conclusions

Instruction that employs a teacher-centered emphasis, in which faculty lecture while students remain relatively passive during class time, tends to be more uniform than instruction with a learner-centered emphasis (Markant et al., 2016). Unlike content-driven lecturing, learner-centered models often punctuate shorter lectures with activities to engage students in the learning process, which can increase student understanding, critical thinking, and overall learning (Lumpkin et al., 2015). These activities can take on many forms, and instructional guidance can vary from direct to minimal or even unguided (Owens et al., 2017). While providing students with active control over their learning experience ("including the selection, sequencing, or pacing of new information") is linked to improved memory (Markant et al., 2016), evidence has also shown that strong instructional guidance is important for novice to intermediate learners (Hood Cattaneo, 2017; Kirschner et al., 2010). Without guidance, these students "do not have sufficient knowledge in long-term memory to prevent unproductive problem-solving search," and they may acquire "misconceptions or incomplete or disorganized knowledge" (Kirschner et al., 2010).

Students who experienced minimal or unguided instruction in learner-centered classrooms may have a negative perception of active learning which must be overcome (Cooper et al., 2017; Hillyard et al., 2010; Owens et al., 2017). Within this context, academic resilience—defined here as the attitudes and behaviors that enable learners to positively respond to new situations and overcome challenges to achieve set goals (Cassidy, 2015, and references therein)—likely plays a key role in a given student's acceptance of or resistance to active learning. That is, the student must exhibit resilience to approach the new active-learning situation positively and to overcome any perceived or real challenges associated with the learner-centered model to succeed in their learning objectives. Constructive learning environments that promote self-efficacy and resilience (e.g., through peer-assisted learning activities, reflection exercises, and classroom support) can result in greater academic success for students (Beri & Kumar, 2018; Cassidy, 2015), as well as increased student satisfaction with their learning environment (Waxman et al., 2003). Students unfamiliar with active learning also may have initial barriers to accepting the teaching methods. These students are more likely to participate if they perceive a low cost and a high value return from active learning (Cooper et al., 2017; Finelli et al., 2018). Increasing students' perception of the value of active learning can be achieved through explanation and facilitation strategies, such as explaining the purpose and benefit of activities and walking around the classroom to assist and engage students, respectively (Finelli et al., 2018; Hillyard et al., 2010; Nguyen et al., 2017; Seidel & Tanner, 2013; Shekhar et al., 2015; Tharayil et al., 2018).

Strategies that support general memory processes such as knowledge integration and recall (Arbuthnott & Krätzig, 2015) are in alignment with many learner-centered activities. For example, students can be prompted to integrate new information in the context of their previous knowledge through activities such as discussions or games (Arbuthnott & Krätzig, 2015). Formative assessments that require students to access information more regularly (Arbuthnott & Krätzig, 2015) and provide a feedback loop for teachers and students to adjust instruction and learning techniques, respectively

(Adkins, 2018), can be given via a variety of exercises. Finally, learning can be distributed over longer periods to allow students time to digest new information (Arbuthnott & Krätzig, 2015) by, for example, using activities that increase creative collaboration and critical thinking (Brown Wright, 2011). While Kirschner et al. (2010) warn that engaging in cognitive activities with minimal instructional guidance is "highly unlikely to result in effective learning" for students, instructors using learner-centered models can use activities to engage students and provide them with active control (Markant et al., 2016) while still ensuring that instruction is well-regulated (Adkins, 2018; Nguyen et al., 2017) and supports "the cognitive processing necessary for learning" (Kirschner et al., 2010). Novice instructors, in particular, may have difficulty implementing effective, well-regulated activities without strong guidance and support from more experienced instructors or their institution (Brown Wright, 2011; McConnell et al., 2017).

Resistance to active learning—from students, instructors, or institutions—potentially can be overcome through evidence-based support and use of specific active learning models with activities that support known memory processes (Markant et al., 2016; Owens et al., 2017; Smith & Cardaciotto, 2011). For example, exploratory writing activities, facilitated small-group discussions, and lecture tutorials have been shown to enhance student learning and engagement (Hillyard et al., 2010; Lumpkin et al., 2015; McConnell et al., 2017; Nguyen et al., 2017). The effectiveness of some activities may depend on numerous variables, including student levels of prior knowledge, class size, learning space design, time or technology limitations, and lesson content and objectives. Therefore, instructors should be reflective and purposeful in their selection of activities (Tharayil et al., 2018). In general, gradually moving toward a learner-centered emphasis is more effective for both teachers and students (Felder & Brent, 1996), as is the continuing use of at least some class time (e.g., $\geq$20%) for lectures (Henderson et al., 2018).

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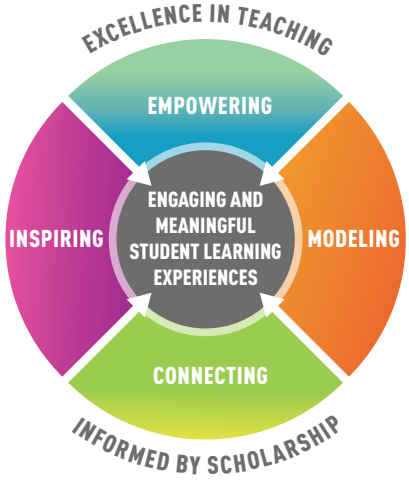
VISION

CTL promotes excellent university teaching that leads to engaging and meaningful learning experiences for students.

MISSION

We pursue this goal through a combination of consultation, facilitation, technology integration, collaboration, and research to advocate for and support evidence-based, responsive, and positive change in teaching and learning. We provide important face-to-face and peer experiences for instructors and extend our reach through blended and online programming.



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