Chapter 16

Student Engagement in Active Learning Classes

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Abstract: As the evidence for the value of active learning in STEM classes grows, questions arise about how to implement such approaches to maximize their effectiveness. Definitions of active learning can lead us to believe that if students are doing content-related work in class rather than listening to lecture, their learning will naturally be improved. But research has shown that this is not necessarily the case. Successful active learning strategies in face-to-face classes depend on a multitude of factors, including question and activity design, faculty prompts, student incentives for participation, and group dynamics. In this chapter I discuss what research suggests is a key underlying reason that these factors impact the results of active learning approaches—their effect on the level of students' cognitive engagement. In this chapter, I discuss the ICAP (*i*nteractive, *c*onstructive, *a*ctive, *p*assive) framework for student engagement and how it manifests in various active learning formats. This model explains how certain student behaviors during active learning evoke deeper processing of ideas, and thus, lead to better student learning.

The evidence for the value of active learning in face-to-face STEM courses is strong–strong enough that some researchers claim that not using such teaching approaches is akin to withholding a therapeutic drug in a medical trial (Freeman et al., 2014). One challenge to interpreting and implementing ideas from such studies is that the phrase *active learning* encompasses a broad array of teaching approaches (as exemplified in this volume). One common general definition of active learning is "Anything that involves students in doing things and thinking about the things they are doing" (Bonwell and Eison, 1991, p. 2). Such definitions may lead us to think that if students are doing anything pertinent in class other than listening to lecture, their learning will naturally be improved, presumably because they are more engaged. But research from a random sample of introductory biology courses across the U.S. has shown that this is not necessarily the case (Andrews et al., 2011). The authors proposed that instructors must be well-trained in active learning approaches to reap its positive effects. Apparently, simply engaging in an activity is a necessary but not sufficient criterion for learning from it. Deconstructing essential ingredients in active learning that contribute to student learning can help us develop more efficient and effective recipes for implementation.

Studies suggest that using active learning effectively depends on a multitude of factors, including question and activity design (e.g., Beatty et al., 2006), faculty prompts (Knight, Wise, and Southard, 2013), student incentives for participation (James, 2006; James, Barbieri, and Garcia, 2008; James and Willoughby, 2011), and group dynamics (Johnson and Johnson, 1999). In this chapter I discuss what research suggests is a key underlying reason that these factors impact the results of active learning approaches—their effect on the level of students' cognitive engagement. I draw on this model to provide suggestions for instructors on ways to enhance students' cognitive engagement in active learning in face-to-face classes.

A Model for Student Engagement

Barkley described student engagement as the intersection of motivation and active learning (2010). Thus, we can think of student engagement as a multidimensional construct that can be parsed into behavioral, emotional, and cognitive components (e.g., Fredericks, Blumenfeld, and Paris, 2004). To illustrate the different levels, imagine students working on an activity during class. They can be participating (behavioral), interested (emotional), and trying to understand what they're doing and how it connects to other ideas (cognitive). On the other hand, students may be joining in because they find it fun (behavioral and emotional), but their minds really aren't on the learning task. Or they can simply be doing what's necessary to get a grade (behavioral only). Behavioral and emotional engagement can empower students to learn and increase their self-efficacy, thus enhancing their motivation (Baldwin, Ebert-May, and Burns, 1999; Fencl and Scheel, 2004, 2005). Student motivation is certainly a critical element in learning (Svinicki, 2016). Thus, we can think of behavioral and emotional engagement as essential pre-requisites for cognitive engagement. For the most immediate payoff from students' investment of time in a specific activity, however, they also need to be deeply cognitively engaged.

In recent years, a model has been proposed and tested that connects various observable student behaviors to potential cognitive actions and subsequent learning outcomes: the *i*nteractive, *c*onstructive, *a*ctive, *p*assive (ICAP) framework (Chi, 2009; Chi and Wylie, 2014 and references therein). This model describes behaviors that instantiate hierarchically different cognitive actions, and the actions in each level subsume those in the levels beneath it. Based on those proposed cognitive actions, different learning change processes result (Figure 16.1). In the ICAP framework, for example, students in a lecture who are only paying attention and not doing anything (e.g., not taking notes) are characterized as *passive*. They are presumably receiving information and mentally storing it but not necessarily linking it to other ideas that will make it easier to access and use. This kind of cognitive activity basically results in the ability to recall or recite information. *Active* engagement, as the term is used in this framework, specifically refers to students not only receiving information but also making connections between the new information and their prior knowledge. Manipulating behaviors, such as transcribing notes and rehearsing, illustrate this level of cognitive activity. Note that in the definition in this framework, students who are only engaging "actively" are not creating new knowledge, but rather merely assimilating or integrating knowledge they are receiving. As a consequence, a logical learning outcome is the ability to apply ideas in a straightforward way.

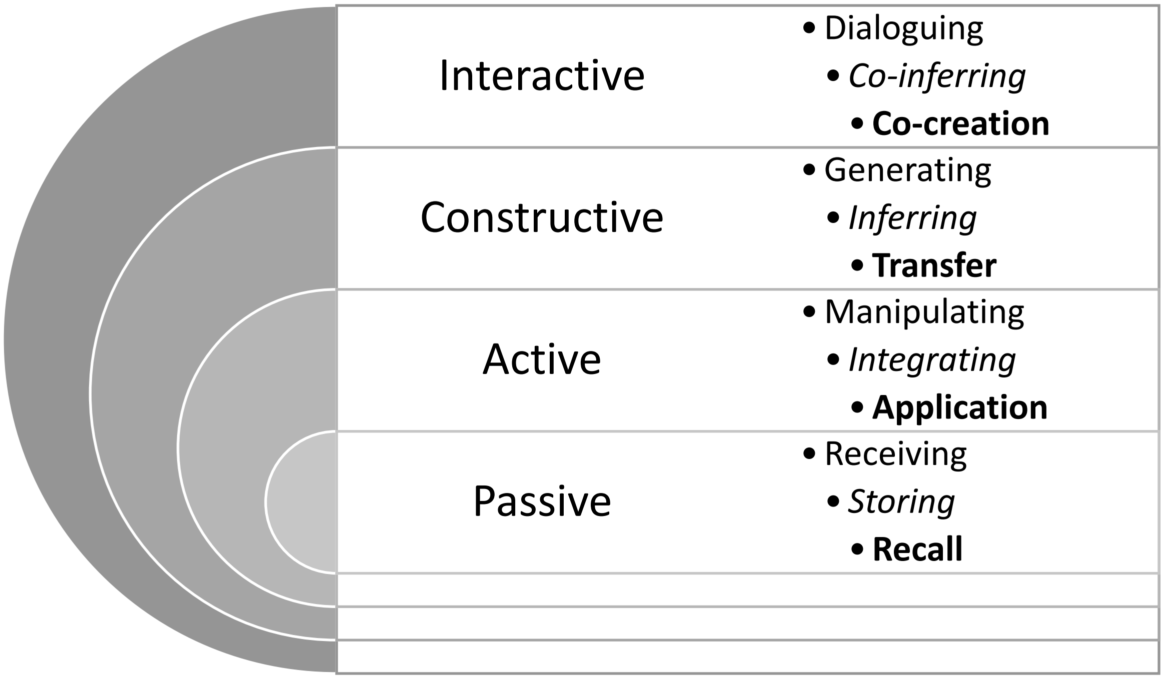

Figure 16.1: Facets of the ICAP Framework of Student Engagement (as proposed and documented in Chi and Wylie, 2014). For each level of engagement, the observed behavior is listed followed by the proposed *cognitive action* (italicized) and the subsequent learning outcome (in BOLD).

The levels of *constructive* and *interactive* in this framework capture deeper cognitive processing actions. Not only are students receiving and manipulating knowledge, but they are also generating new understandings for themselves—either alone or in collaboration with others, respectively. Constructive behaviors (not to be confused with ideas in the educational philosophy of *constructivism*) involve cognitive actions such as inferring, embodied in activities such as taking notes in one's own words, explaining ideas, arguing, asking questions, posing problems, and so on. To be interactive, *each* participant must be constructive and address the others' contributions in a reciprocal, symbiotic fashion. Because this framework is based on observable behaviors, students may need to generate some product to delineate exactly how they are engaging. For example, students may be actively processing ideas although they look passive, or they may actually be recalling something they learned earlier when it appears that they are being constructive. But in general, this model provides a useful template for thinking about the cognitive actions active learning assignments are likely to evoke in students.

One of the strengths of the ICAP framework is that it draws on both cognitivist and sociocultural theories of group learning (theories discussed in Wood et al., 2014). Cognitivist theory, building on work by Piaget (1970) and Ausubel (1978), posits that collaborative learning acts primarily to trigger important mental processes in the individual. These processes, such as self-explaining, accessing and connecting prior knowledge, and transferring ideas to new contexts, are captured in the active and constructive modes of ICAP. But the interactive mode in the ICAP model also encompasses socially-mediated learning. In theories of sociocultural learning, the environment acts as a moderator for making meaning, and discourse drives the co-construction of knowledge in the learners (Vygotsky, 1978). To be interactive, students must be taking turns engaging in constructive behaviors–explaining, debating, questioning–pushing each other beyond their individual understanding.

Active learning in general, as discussed in this volume, refers to pedagogical approaches that evoke behaviors encompassed by every ICAP level of engagement other than the passive (Chi et al., 2018). But given the different kinds of cognitive actions purportedly engendered by the different behaviors, the learning outcomes achieved through active learning depend on precisely *how* students are engaging. Herein lies the importance of activity design, participant incentives, and group dynamics in realizing the rewards of active learning. For example, having students collaboratively fill out a worksheet summarizing ideas presented in lecture is an *active* exercise, but it won't necessarily elicit *constructive* engagement unless it asks students to infer some application or next step not explicitly provided in the information available. In addition, if the worksheet poses a new question for students, but the student incentives and group dynamics are such that students rely on one student to answer, that student benefits from constructive engagement, whereas the others are primarily just active or even passive. Below I expand on each of these facets of active learning and their relationship to the ICAP framework of engagement.

Activity Design and Prompts

Effective design of active learning exercises begins with a specific learning goal and incorporates a correspondingly appropriate level of cognitive demand (Barkley, Major, and Cross, 2014). Group interaction can help students process ideas and make connections, cultivating the transfer of ideas to long-term memory. But group discussions also contribute to cognitive load as students struggle to access and remember their own ideas as well as keep up with changing speakers and topics (discussed in Nokes-Malach et al., 2015). Thus, asking groups to accomplish tasks that could be performed easily enough individually actually imposes an undue burden on the learners. Groups become an asset when the task requires cognitive challenges such as generating new knowledge, applying ideas to novel contexts, or thinking through multiple perspectives. In these cases, members of the group contribute by complementing each other's prior knowledge, correcting errors, and importantly, participating in co-creation of meaning. But if tasks are beyond the capabilities of even the group, then learners will be demotivated to engage.

One way to gauge the cognitive challenge of various tasks is to assess the activity against Bloom's taxonomy of cognitive learning (Crowe, Dirks, and Wenderoth, 2008). Bloom's taxonomy (original Bloom and Krathwohl, 1956) describes various mental tasks as a hierarchy starting from remembering through comprehending, applying, analyzing, evaluating, to creating (as revised by Anderson and Krathwohl, 2001). Building on this groundwork, instructors can formulate more productive questions that engage students in meaningful dialogue (Anastasio and Ingram, 2018).

The ICAP framework can give us additional guidance in how to use activities to maximize students' cognitive outcomes. For example, interrupting lectures to allow time for students to check understanding via a quick think-pair-share or peer discussion can recapture students' attention and help them encode information by moving them from passive to active engagement. But using group activities only for simple practice or drill exercises may not enhance learning outcomes over and above what students achieve from working on their own. Indeed, a study of two sections of a nonmajors' biology course showed that group work improved students' performance on higher-order test questions, but not on lower-order questions (Linton, Farmer, and Peterson, 2014). This result makes sense in the ICAP framework if we recognize that students working *actively* individually can store new information and make connections to prior knowledge allowing them to answer lower-order recall and application questions. But for students to connect and transfer ideas to answer higher-order questions they need to be making inferences via constructive and interactive engagement.

One traditional explanation of why students benefit from group discussions is that students who are more knowledgeable teach students who are less so. That is, presumably the constructive engagement of the more knowledgeable students promotes active learning within the other individuals. This aspect of the framework may help explain studies that show that higher-achieving students often benefit most from active learning (Beichner et al., 2007; Jensen and Lawson, 2011)–they probably spend more time proportionately explaining ideas to other students. However, one study conducted in a large introductory genetics class taught using peer instruction (PI; Smith et al., 2009) underscored the unique value of interaction as discussed in the ICAP framework. Peer instruction is a structured form of active learning in which the focus is on students answering conceptual questions before and active group discussion (Mazur, 1997; see chapter 14 in this volume). In this study, the authors analyzed results from groups answering PI questions in which no individual student answered a particular question correctly either before or after discussion. They then looked at responses from the individual students in these groups when asked a follow-up isomorphous question and found that they were much more likely to answer those questions correctly. This finding suggests that interactive engagement has the capability of cultivating students' understanding over and above that of any individual.

Given the potential power of interactive engagement to promote student learning, then finding ways to foster better interaction is essential in activity design. A study in a large introductory biology class examined the impact of two kinds of tasks, a "loosely-structured" single-group activity and a "structured," multi-group jigsaw activity, on student outcomes (Wiggins et al., 2017a). Students in both activity conditions were given the same content. The two activity designs were formulated to foster primarily constructive engagement in one case and predominantly interactive engagement in the other. In the "loosely structured" case, students worked in groups on a three-part worksheet. The instructions required that students integrate concepts, do comparisons, and predict outcomes of content applied in new situations–prompts to trigger constructive engagement. The "structured" case was designed as a jigsaw activity. Students worked independently on one part of the worksheet, and then joined a group of other students who worked on the same part to discuss their responses. Finally, those students distributed themselves into new groups in which students had worked on different sections of the worksheet. These mixed groups discussed the whole worksheet using the instructor's specific, guiding prompts that cultivated their interactive engagement as defined in the ICAP model. The authors found statistically significantly greater learning gains (though subtle) when using the jigsaw activity. They attributed this gain to the greater interaction they observed in the scripted, structured group activity.

Activity instructions are essential in prompting students to engage more productively. For example, student interaction when discussing clicker questions was enhanced when the instructor explicitly asked students to explain their answers (Knight et al., 2013). Being so obvious may be particularly important when the active learning exercise involves students in choosing from a given list of answers, a common practice in the pedagogical approaches of PI and team-based learning (Michaelsen, Knight, and Fink, 2004; see chapter 21 this volume). In these instances, students may perceive the goal of the exercise to be simply choosing the right answer. The instructor's goal of making students think can be lost in the pressure of the moment. For example, studies in PI classes in physics and astronomy classes (James and Willoughby, 2011; Wood et al., 2014), showed that students can choose the right answer without understanding. This result often occurred when students succumbed to peer pressure or relied on clues such as the instructor's wording or terms recently used. Fortunately, however, students could benefit from the discussion in terms of their development of conceptual understanding whether or not it was reflected in their answer (Wood et al, 2014). Specifically, directing student groups to differentiate between ideas and compare predictions and outcomes in various contexts can catalyze students' participation in deeper meaning-making as evidenced in studies of group discourse (Young and Talanquer, 2013).

A study of K-12 teachers trained in the ICAP framework of engagement examined how teachers designed activities that were meant to elicit active, constructive, or interactive modes of engagement (Chi et al., 2018). The authors coded the teacher-generated activity directions and questions by looking for verbs and associated noun phrases that corresponded with the various behavioral levels. Teachers more often used language in activity prompts that asked students to manipulate ideas (triggering active engagement) even when they intended exercises to be constructive or interactive. Their assessments of student learning also tended to lean primarily toward asking students to manipulate information (active) rather than make inferences (constructive). But in those cases in which teachers were able at least in part to implement constructive (i.e., generative) activities, student learning was substantially improved over those cases in which exercises were predominantly only active. Worksheet questions that cued constructive engagement included verbs such as *compare*, *construct*, *defend*, *generate*, *graph*, *predict*, and *represent,* for example.

Incentives for Participation

Working as part of a group can be challenging to students both cognitively and socially. In addition to the cognitive load issues mentioned earlier, students who are shy or introverted may prefer not to interact in the group. Also, students may feel that their peers' ideas are not as valuable as their instructor's (Gravett, 2018). Importantly, however, in one study in a large enrollment anatomy and physiology course, student buy-in to active learning positively correlated with their self-regulating behaviors and learning outcomes (Cavanagh et al., 2016). Thus, it is important that instructors "sell" participation. Explaining how interacting with peers enhances learning is important. But instructors also usually need to provide some grading incentive to encourage group participation. Grades in essence give concrete expression to the instructor's belief in the importance of interaction and give students a payoff for undertaking the risk.

But extrinsic incentives can be double-edged swords. In some studies of undergraduate astronomy classes taught using PI, if instructors graded clicker questions for correctness, students discussed less and relied more on the student who seemed most knowledgeable (James, 2006; James et al., 2008). Faculty in science courses also report, however, that they use grading for correctness to prevent students from mindlessly clicking on answers to earn their participation points (Hodges et al., 2017). Balancing grading to include components of individual and group effort can both promote individual accountability and validate the importance of collaboration.

Group Dynamics

Faculty often express two concerns about active learning that involves groups–"What if students don't do their share of the work?" and its converse, "What if one student dominates the discussion?" Instructors may feel ill-equipped to manage the social processes of active learning, especially when it entails students working in groups. And when trying group work for the first time, any dysfunctional groups can totally overshadow other positive outcomes (e.g., Felder and Brent, 2016, p. 267). Students, too, can find aspects of group learning off-putting (discussed in chapter 57 this volume).

Students may not all contribute equally to group work because they assume that other members will carry the load. They may also not participate readily because of the fear of judgement by their peers. These social dimensions of group work are addressed in social interdependence theory (Johnson and Johnson, 1999). The theory says that critical elements of successful cooperative learning include that the group exhibits positive interdependence, shows accountability of both self and group, interacts in ways to encourage and evoke processing of ideas, demonstrates supportive social behavior, and engages in group processing. These behaviors, called *promotive interaction*, provide optimal conditions for interactive engagement in the ICAP framework.

Student comfort with active learning, especially group work, can be an important factor in their willingness to engage. Many proponents of group work advocate for instructor-formed rather than self-selected groups to encourage diversity, avoid putting the spotlight on shy or under-represented students, and discourage groupthink (Davis, 2009). Students, however, may not feel at ease under such circumstances. In one study in a biology class, the women in the class reported valuing group work less unless they could form groups with their friends (Eddy et al., 2015). Another study found that LGBTQIA students can feel stressed when in groups of students they don't know, unsure how they may be perceived (Cooper and Brownell, 2016). Such unease can obviously impact students' willingness to engage other students in expressing disagreement and debating ideas–critical activities for constructive and interactive engagement. A study in a large introductory biology class that compared differently structured tasks (as described in the section on activity design) also examined student perceptions of their experience (Theobald et al., 2017). Students surveyed who said that they were "comfortable" with group work scored 27.5% higher on content mastery. One of the strongest factors affecting their comfort level was that they were working with friends (though working with a friend did not impact scores). Students in the more highly-structured jigsaw activity were 67% *less* likely to report that the group included a dominator. The authors theorized that orchestrating activities can thus help balance out student differences that would otherwise disrupt interaction.

If instructors allow students to self-select, however, will their learning be affected? One study in a large introductory physics course (Harlow et al., 2016) looked at the effect of group composition on learning outcomes on a standardized measure, the Force Concept Inventory (Hestenes et al., 1992). The authors constructed groups of students of mixed or similar abilities as determined by a pre-test, of differing sizes (3 or 4), and consisting of only one or of more women. When they compared score gains on the pre- versus post-inventory, they found no statistically significant differences based on how the groups were formed.

In our diverse classrooms, students may not come from cultural traditions that expect or value student contributions to knowledge generation in the classroom in the same way. Group interactions may be epistemologically as well as socially challenging for these students. One study in a biology course found that international students were more likely to report that their ability to participate in group discussion was negatively affected by a dominating student (Eddy et al., 2015). Likewise, although the research supporting the positive outcomes from active learning overall are strong, some groups may benefit more than others. Research in a large biology class over time found that more structured pedagogical approaches that included group discussions helped all students, but most benefited those students with less advantaged educational or economic backgrounds (Haak et al., 2011) or Black and first-generation students (Eddy and Hogan, 2014). On the other hand, in a study of physics classes taught using active learning approaches, failure rates of Native American, Asian-American, and Hispanic students did not decrease compared to lecture-based courses (Beichner et al., 2007). More research is needed to explicate the ways that students from different cultures experience interactive pedagogies.

If interactive engagement is important for maximal learning, then finding a way to give students from different cultural or social norms "voice" may be crucial. One adjustment may be fairly simple–reducing the size of the group. One study validating the ICAP framework was done by studying dyads (e.g., Chi and Menekse, 2015). In addition, the more scripted the activity, the more students may feel that the instructor is authorizing them to step out of their norm. Asking students to write individually on an activity before group discussion can not only foster more equitable discussion, but it may also have the advantage of eliciting constructive engagement from those students who may be more hesitant to speak aloud.

Generally, what may be most important for student learning in groups is that students become comfortable working with each other in the classroom environment. They need to feel that they can argue and debate without fear of insult or reprisal–from each other or you. A positive, challenging yet supportive, dynamic can be created in two general ways–allowing students to self-select into groups or creating stable groups and providing guidance in developing group cohesion. In a study of an introductory physics class taught using PI, when groups remained stable students achieved higher scores for expert-like thinking on the Colorado Learning Attitudes about Science survey (Zhang et al., 2017). We might infer that by working together over time, students became more accustomed to pushing each other in their understandings and beliefs–i.e., interactive engagement. They must also feel that they have your support in this level of engagement as I discuss next.

The Importance of Teacher Behaviors in Student Engagement

Obviously, instructors play the critical role in designing activities, incentives, and group processes that affect student outcomes from active learning. But the instructor is also instrumental in fostering a climate conducive to students' deep constructive and interactive engagement. During active learning, students are asked to contribute to an apparent anarchic, chaotic dynamic and expose themselves to the judgement of strangers. They need some assurance from instructors that undertaking such a risk is worth it. For example, the literature on resistance to active learning notes that various instructor behaviors can be demotivating for students engaging in active learning. Seidel and Tanner (2013), drawing on other work (Kearney et al., 1991), listed such behaviors as those that epitomize an instructor's lack of organization and planning, respect for students, or interest in the course or students. Conversely, behaviors that increase the perception of the instructor's competence, transparency, and involvement help promote students' trust in the instructor and their willingness to follow along (Tharayil et al., 2017). For example, in one study in a large anatomy and physiology course, students' trust in the instructor (measured as "instructor's understanding, acceptance, and care") positively correlated with their commitment and engagement in active learning (Cavanagh et al., 2018).

Buskist et al. (2018) proposed five key faculty practices that enhance student engagement based on the research: recognizing the social and psychological context of learning; planning for engagement; building rapport with students; being passionate about content and teaching; and anticipating that engagement is sometimes chaotic. We do not yet have research for the specific effect of teacher *behaviors* on the ICAP framework of engagement, but we can hypothesize based on other aspects of teacher behavior on learning. For example, we have already discussed the importance of designing the social environment to be conducive to students' comfort with interaction and of planning the activity to push students into more interactive engagement. The affective elements in instructor behavior, e.g., rapport, enthusiasm, and comfort with chaos, touch on the power of connection and relation in learning. A number of studies have shown that students report more engagement and learning when faculty cultivate interaction (e.g., see Umbach and Wawrzynski, 2005; Kim and Sax, 2009). As part of the research in the development of a survey to measure students' perceptions of their engagement in active learning (Wiggins et al., 2017b), authors identified three significant factors from students: the perceived usefulness of the group activity in promoting learning; personal effort students expended; and perceived effort the instructor put into the activity. The instructor's contribution included aspects such as preparedness, availability during the exercise, and enthusiasm for the activity and topic.

One study that looked specifically at instructor-student and student-student rapport showed that instructor-student rapport consistently predicted student participation and cognitive learning (Frisby and Martin, 2010). One factor in instructor rapport is the concept of instructor *immediacy.* Immediacy encompasses verbal and non-verbal behaviors that act to reduce perceived psychological barriers between faculty and student (Andersen, 1979; Andersen and Andersen, 1982). One relatively simple practice that can enhance an instructor's immediacy with students is learning their names. In a study of a large enrollment upper-level biology course (Cooper et al., 2017), students were queried about why it was important to them that the instructor knew their name. The top responses included that they felt more valued, more invested in the course, more comfortable seeking help, that the instructor cared about them, and that it built their relationship with the instructor. Interestingly, the instructor only needed to know about 50% of students' names for more than three-quarters of the students to *think* the instructor knew their name.

Instructors who create a classroom in which inquiry, respectful debate, and risk-taking are encouraged–and in which being "wrong" is recognized as an important opportunity for learning–are modeling the best practices of interactive engagement for their students. Essentially these instructor characteristics demonstrate belief in the processes you are asking students to undertake, and affirm that you value their engagement.

Key Practices to Promote Cognitive Engagement

Based on the ICAP Framework and accompanying research, practices that instructors employ can be powerful inducements to students' deep cognitive engagement with active learning. Effective implementation depends on instructors' desires for, demeanor around, and design of student experiences. I expand on these ideas below.

Make Active Learning Serve Your Session Goals. The goal of active learning is that students are learning, not just that they're active. As you design activities, think first about what you want students to come away with from their time on task. Different goals require different kinds of engagement. For example:

- To clarify students' understanding of a concept use think-pair-share or peer discussion and prompt them to explain the idea to each other in their own words (active/constructive engagement).
- To develop students' ability to apply and transfer their learning to novel situations cue students to explain, infer, predict, induce, or debate possibilities–beyond the information provided in the materials (constructive/interactive engagement).
- To maximize learning, design it to foster collaboration, e.g., script interactive steps or divide and then merge group tasks in jigsaw activities (interactive).

Adopt Teacher Behaviors that Promote Trust and Reduce Student Resistance. Robust interaction can seem fraught to students, and they need to know that you are on their side. Students appreciate it when instructors are involved in, and enthusiastic about, active learning and are clear as to its purpose. Ways to promote connection and trust and circumvent resistance include:

- Learning students' names (to the degree possible)
- Organizing activities with clear, stated goals and expectations
- Circulating around the room and talking with students during active learning
- Being respectful and supportive of students' responses and struggles
- Celebrating diverse approaches and acknowledging the importance of making mistakes
- Grading on participation, not, or not only, on correctness of responses
- Creating exercises that actually require and reward participation

Design and Describe Activities to Elicit Constructive and Interactive Engagement. To use active learning to develop students' higher order thinking, you need to create activity directions and questions that engage students constructively and interactively. Steps that can help include:

- Introducing interaction incrementally
- Using verbs for activity prompts from higher orders of Bloom's taxonomy–e.g., analyze, compare, discriminate, evaluate, formulate, hypothesize
- Assigning problems that *cannot* be solved via plug and chug–context-rich problems or case studies based on authentic situations that may include too much and/or too little information
- Modeling productive, civil dialogue and debate in class
- Providing sample templates or scripts for dialogues
- Assessing students' work for evidence of collaboration, not only or primarily correctness
- Requiring students to reflect on group process and products

Conclusion

Although it's tempting to think of active learning as the magic bullet in student learning, promoting human brain change is too complex for a one-size-fits-all solution (Hodges, 2015). But by building on the research on student engagement in active learning, you can increase your chances of reaching more of your students more of the time. Fostering students' constructive and interactive engagement can empower them to take their learning to a whole new level–one where they take responsibility and begin to develop the skills of expert learners.

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