

## Summary of Class Size Effects on Student Performance

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Overall, the literature suggests that class size does impact student performance, but that this effect is mediated by a multitude of factors, including: method of instruction, course objectives, assignments, student involvement in the learning process, frequency of instructor feedback to and interaction with students, students' cognitive level in the classroom, and learning strategies used by students outside class (see Cuseo, 2007 for a review). Much of the research conducted on class size effects has been in the domain of K-12 education, and only more recently have there been some studies investigating effects of class size at the university level. The literature on the effects of class size is somewhat inconclusive, as some studies have shown no effect of class size on student performance or satisfaction (e.g., Bellante, 1972; Hill, 1998; Jarvis, 2007; Kennedy & Siegfried, 1997), while other studies have shown a negative effect of increasing class size (e.g., Bedard & Kuhn, 2008; Kokkelenberg, Dillon, & Christy, 2006). Findings have been inconsistent even when studying the same data set (e.g., Kennedy & Siegfried, 1997; Lopus & Maxwell, 1995; Zietz & Cochran, 1997). Such contradictory results are often due to unstandardized definitions of class sizes (e.g., one study referred to a class of 12 as small, while another referred to a class of 40 as small), variations in the level of analysis (i.e., class level or student level), different specifications of the expected relationship between class size and student performance (i.e., linear, quadratic, etc.), and different specifications of control vectors in analysis. Additionally, sample sizes range from a single instructor or course to many instructors or courses. Outcome measures are also varied, including course grades, grade point averages, standardized test scores, and course evaluation data (student ratings).

Generally, for those studies that find an effect of class size, there seems to be a point at which the negative impact of increased class size tapers off to minimal effects (Bedard & Kuhn, 2008; Johnson, 2010; Kokkelenberg et al., 2006). Bedard and Kuhn (2008) suggest that classes of 80-50 students are relatively insensitive to class size effects, while Kokkelenberg et al. (2006) suggest that the probability of students achieving a higher GPA decreases substantially up to a class size of 20-40 students and more gradually through larger class sizes. Others have suggested that larger effects on student achievement occur when class sizes drop to 15 or lower (Glass & Smith, 1978). Thus, further decreasing enrollment in smaller classes, such as from sections of 25 students to 20 or fewer students, might potentially have a larger impact on student performance than reducing class size in larger courses. However, for studies that find negative effects of increasing class size, these effects are consistently systematically small (see Hattie, 2006 for a review). It is also important to note that positive effects of smaller class size on student performance do not necessarily equate to increased student *learning*, as outcome measures such as grades are considered a proxy for knowledge (Kokkelenberg et al., 2006) and there are multiple factors beyond learning that contribute to student performance (e.g., student motivation, prior knowledge).

## Summary of Class Size Effects on Student Performance

Results are further complicated by the fact that class size is often confounded with other factors such as teaching style or student motivation. Smaller classes more easily lend themselves to active and individualized learning for students, which varies greatly from the typical lecture method used in many larger courses (Benton & Pallett, 2013). Smaller classes are potentially more interactive, engaging, and individualized, and they may have rather different assignments than larger classes (Biddle & Berliner, 2002; Johnson, 2010). Smaller classes also enable students to engage in a wider range of higher cognitive processes, such as analysis, synthesis, and evaluation (Fischer & Grant, 1983). Such advantages of small class sizes need to be capitalized upon by faculty, but instructors sometimes teach small classes the same way they would teach their larger courses (see Hattie, 2006 for a review).

Despite students' belief that quality of instruction impacts their learning rather than class size (Litke, 1995), students tend to rate instructors' teaching quality higher when class size is smaller (e.g., Kwan, 1999) and tend to have negative attitudes toward large classes in college (McConnell & Sosin, 1984). Some have suggested that student work habits and motivation are actually more important predictors of performance on relevant learning objectives than class size, although inspiring and encouraging students in larger classes can be hard (Benton & Pallett, 2013).

Class size and teaching methods have also been demonstrated to vary by discipline (Johnson, 2010). Some studies have indicated that effects of class size vary by discipline, and even within a discipline (e.g., McConnell & Sosin, 1984; Raimondo, Esposito, & Gershenberg, 1990). Yet, discipline specific research, especially for mathematics and foreign language, are relatively sparse. In one foreign language pilot study comparing student perceptions and teacher concerns, students enrolled in a larger class (n=22) who had never experienced a small class environment thought that their class size was ideal, whereas students enrolled in the smaller class (n=12) who were accustomed to class sizes of 20-30 students thought an ideal class size would be 15-20 students (Johnson & Arenas, 1995). Yet, students in both small and large classes thought that oral communication activities were effective and reported that peer-correction and discussion or practice of grammar in small groups helped them learn material. This is consistent with Locastro's (1989) article relating to student and instructor class size preferences, wherein the preferred class size for both students and faculty was 10-20 students and an upper limit of 25 students was recommended as a reasonable compromise.

Findings specific to mathematics include little to no benefit on student learning and achievement in smaller classes (Benton & Pallett, 2013). One study of class size in calculus courses found that any potential effect of class size on student performance is mediated by the individual instructor and the instructor's ability or attitude (Jarvis, 2007). Furthermore, student achievement on a final exam was better for larger classes with more effective instructors than smaller classes with less effective instructors (Jarvis, 2007). Another study of pre-calculus courses demonstrated that transitioning to problem-based learning in a relatively large class

### Summary of Class Size Effects on Student Performance

( $n=75$ ) led to significantly higher exam scores than a smaller lecture-based class ( $n=40$ ), a large traditional lecture-based class (combined  $n=138$  for two control classes), or a large class using small collaborative groups ( $n=61$ ; Olson, Cooper, & Lougheed, 2011). This again suggests that pedagogy may be more important than class size alone.

However, the same study also found that this effect did not extend beyond the current course to subsequent calculus performance (Olson, Cooper, & Lougheed, 2011). Similarly, there is some curiosity about whether class size effects transfer or persist to subsequent courses (e.g., Glass, Cahen, Smith, & Filby, 1982). Interestingly, there has been some research demonstrating that further reducing small class sizes (from about 24 to a maximum of 19) in first-year writing courses improved pass rates and retention and decreased the number of students who withdrew or failed (Schorn, 2014). This is consistent with the idea that enrolling first-year students in larger lecture style courses that encourage more passive participation may predispose them to develop maladaptive mental habits or attitudes towards learning that persist throughout the remainder of their college experience (Cuseo, 2007). Furthermore, some studies have shown that students are more likely to take additional courses in a particular academic discipline if the prior discipline-specific course in which they were enrolled contained either small-group peer discussions (Bruxton & Crull, 1982, as cited in Cuseo, 2007) or instructors who lecture less and act more as facilitators rather than experts (McKeachie, Lin, Moffet, & Daugherty, 1978, as cited in Cuseo, 2007). Thus, smaller class sizes may have an especially profound impact for first-year students and students new to a particular discipline in terms of retention or motivation to continue with a particular major.

Another consideration is the “overall load” of the instructor, or the number of classes or sections the instructor is teaching concurrently. It has been found that higher instructor workload is associated with lower student ratings of instructor effectiveness (e.g., Monks & Schmidt, 2010; Ozgungor & Duru, 2014). If class size is decreased but overall load is still large (i.e., multiple sections or courses), the potential advantages or benefits of small class size may be diminished. The total number of students that an instructor is responsible for teaching in a term influences how instructors structure their courses (Monks & Schmidt, 2010). Instructors with large overall load may not take advantage of the affordances of small class size, as they may not have the time to invest in course planning, grading or feedback, or individualized attention to students. This is especially true for writing-intensive courses, wherein a conservative estimate of time necessary to dedicate to reading, grading, and providing written and face-to-face feedback is 190 minutes per student (Schorn, 2014).

Taken together, the impact of decreasing class sizes from 25 students to 18 students, particularly in math and foreign language courses, will depend on multiple factors: instructor pedagogy or teaching style, overall load of the instructor, and student attitudes or motivation. Smaller class size alone is not necessarily sufficient to positively impact student achievement, as it is the combination of these factors that contribute to student performance.

Summary of Class Size Effects on Student Performance

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Summary of Class Size Effects on Student Performance

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Summary of Class Size Effects on Student Performance

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