Making Large Classes Work for You and Your Students

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Abstract

Engineering educators tend to prefer small classes. However, rising enrollments and declining per-student funding make large classes a reality in many programs. But look on the bright side. Large classes offer many opportunities that small classes do not. If you are prepared to take advantage of them, you can make large classes work to advantage for yourself and your students. This paper considers the perceived handicaps of large courses, and contrasts them with a large number of potential benefits, both to students and faculty.

Keywords: large classes, active learning, cooperative learning, assessment, teaching assistants, independent study

1. Introduction

Hard numbers are difficult to come by, but many observers have noted that large classes seem to be becoming more common. Several reasons are cited, including the desire to democratize higher education by enrolling students from a wider range of socioeconomic backgrounds, declining per-student support from governments after the Great Recession, and the growing popularity of STEM majors such as Computer Science. All of these factors make it more likely that engineering educators will be called on to teach large classes, which depending on the discipline, may comprise 80 to 800 or more students.

Conventional wisdom says that this is unfortunate. Large lectures depersonalize education. Students' attention dwindles quickly [1, 2]. Their grades are not as good [3, 4]. Student-evaluation scores tend to be lower in large classes [5, 6], which indicates that students are usually happier in smaller classes. Engineering instructors strongly prefer teaching smaller classes [7]. Lynch and Pappas [8] list ten problems with large classes, most of which have to do with relationships between students and faculty members.

Pervasive as these perceptions are, they give an incomplete picture. Large classes have many advantages and opportunities that are less well known, but can be exploited by instructors who are aware of them. They are derived from the author's discussions with other faculty, an attempt to organize a panel on this topic, and posts on various teaching-related mailing lists.[1] This paper identifies twelve such areas.

2. Benefits to students

Large classes can improve the student experience in at least four ways.

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[1] The ASEE Engineering Technology listserv, ETD-L@listproc.tamu.edu; SIGCSE-members@listserv.acm.org, for Computer Science educators; and discussion@podnetwork.org, from the Professional and Organizational Development Network

The first is **community**. A large class can grow into a supportive learning community. Students have more opportunity to partner with, and learn from, other students. Questions are answered more quickly on Piazza or a message board. Students can learn from their peers. Clicker-style polling provides immediate feedback, regardless of class size. It can even work better in a large class, since there is bound to be a critical mass of students who have chosen different answers. One student from each group can be called on to defend the answer they have chosen. Goff et al. [9] discuss strategies for using clickers effectively in large classes.

One instructor, who teaches Construction Management, says he tries to get students talking to other students they don't know in the class, because that is a skill they will need in the construction industry. He has them create multiple GroupMe accounts so that they will get experience messaging people they have never met. They take group quizzes, talking to different people in the class to improve their 3D spatial visualization skills. A large class is more conducive to this kind or exercise.

The second is **diversity**. A large class is, almost by nature, inclusive and diverse. Minorities are more likely to be able to find other students who are "like them." For example, a student is far less likely to be the only African-American woman in a class of 200 than in a class of 25. Isolation can be seriously demotivating, so a large class feels like a safer space. And a course with a large staff is more likely to have at least one female TA who can serve as a role model to the women students.

One respondent identified **competition** as an advantage of large classes. In a small class, there may be only one or two outstanding students. Just as in a race with only one dominant runner, the leader will not have the competition necessary to push him or her to their peak performance. In a large class, they can be motivated to do more to stand out and catch the attention of the instructor.

Finally, large classes are opportunities to **disseminate good teaching** to a wider audience. In their 2014 book *How College Works*, Takacs and Chambliss [10] opine, "Good lecturers should teach large classes where they can benefit the most students, especially at the introductory level, where professors can open new intellectual horizons and legitimize the academic enterprise." One of my respondents added, "I would never have had classes from Hal Abelson and Gian-Carlo Rota if large classes weren't allowed. A single star lecturer can reach hundreds of students in a large lecture. And Rota knew all our names — not something we'd get from a recording!"

3. Benefits to staff

In many departments, faculty get more **teaching credit** for teaching larger classes. For example, the author's department used to have a rule that a class of more than 100 students counted as 1.5 classes. This allows the instructor to focus on fewer classes and do a better job on those, while having more time for research.

Large classes are a boon to **recruitment.** An instructor of a large class becomes known to a lot more students, and these students are more likely to consider working with them later on. You may become their graduate advisor, or advisor for an undergraduate research project. A large class is also a great place to recruit for independent-study students who may assist one of your research projects or generate resources for later offerings of the same course. The author has worked with as many as 40 students per year on such projects, and could not have enlisted so many without regularly teaching classes of 100–150 students.

In fact, at schools with a paucity of TAs, independent-study students can be recruited to help support the course. While it wouldn't be appropriate to have them grade papers, they can design new experiments, write infrastructure code, work out active-learning exercises, or mentor student teams. An instructor with good recruitment practices can develop a self-supporting ecosystem, supported by independent-study students in numbers proportional to the size of the course [11, 12].

Yale Patt, the Ernest Cockrell, Jr. Centennial Chair in Engineering at the University of Texas at Austin has been teaching the freshman intro to computing course for more than 20 years to more than 400 students each time he teaches it. He admits that large classes do come with extra challenges, but says, "It certainly has been a welcome additional benefit for me that the students I teach as freshmen enjoy the course and subsequently welcome the opportunity to work with me in advanced courses and research … I personally put a lot of effort into my undergraduate teaching. I admit that I enjoy the fact that the extra work comes with extra benefit in that there are a lot more students I get to interact with in my classroom."

Professional development. Teaching assistants, too, benefit from working with a large class. First there is the sense of camaraderie with the other TAs and the opportunity to learn from them (another manifestation of community, as above). Beyond that, in a really large class (say, 200 or more) an experienced TA can take on a management role that in other situations would be the responsibility of faculty. The head TA (or sometimes, "head grader") may be responsible for assigning tasks to other TAs and watching over how they execute them. The TA may even help teach the course from the front of the classroom. Lynch and Pappas [8] explain, "Having two authority figures in front of the class is beneficial in a number of ways. It creates a more dynamic learning environment that helps with student engagement because the exchange between a professor and teaching assistant helps capture and maintain attention during instruction. ... It also helps break down barriers for students who may struggle to talk in class or approach the professor one-on-one, which is especially beneficial if a female teaching assistant is paired with a male professor, or vice versa."

4. Benefits to both students and staff

Five characteristics of large classes are helpful to both students and instructors. In schools that have teaching assistants, TA support hours are usually assigned proportional to enrollment in the

course. A course with several TAs has the opportunity for **specialization**. TAs can specialize in different kinds of work (e.g., maintaining the gradebook, managing the web site, setting up programming environments). One particularly effective strategy is to have a TA organize peer mentoring among students, bringing together students who need help and students who can furnish help, perhaps for extra credit. With a staff of TAs, when one of them is ill or busy with other work, someone else is always available to cover for them. TAs are more effective too, in part because they collectively have enough experience to solve one another's problems.

In courses that are huge, having more than a handful of TAs, management of office hours becomes an issue. Students may face long waiting times and impersonal interactions. Instructors wonder about whether students are being effectively served. Fortunately, software is available to mitigate these problems. My Digital Hand (mydigitalhand.org) has students sign in and be added to a waiting list. Students can be served FCFS or grouped according to the questions they have. The software keeps TAs aware of how many students are waiting, allowing them to allocate their time most effectively. Large classes have more office hours than small classes overall, and the ability to automatically group students by the issue they are facing should give them a better opportunity to get help in a large class than they would have in a small class that had a single TA, or perhaps no TA at all.

Large classes have several benefits for **assessment**. Grading is more efficient, as startup over-head plays less of a role. Students may receive more formative feedback, because a larger staff may have the time to configure tools to provide it. Software is available for automatically grading work that requires symbolic formulas as answers, or for computer programs that need to produce a specified behavior. It takes effort to configure these tools, but once set up, they provide formative feedback to every class member with no additional work on the part of the course staff.

For classroom assessment, large classes offer economies of scale. Assessing teaching effectiveness is easier, simply because there is more evidence. Students can be surveyed after class to see how well techniques have worked. In a small class, this might lead to survey fatigue, but in a large class, a different subset can be surveyed each class day [13]. The instructor can determine more quickly when a technique is not working, and can make corrections sooner.

In these days of easy student access to solution manuals [14], it is helpful to involve both TAs and students in **content generation.** Teaching assistants can often provide suggestions for improving content, delivery, and management that go far beyond what the instructor alone could devise. Instructors sometimes have their TAs draft problems for homework or exams. In the author's case, the course staff (instructor + TAs) divvy up the lectures in advance, with each person being responsible for making up questions on specific classes. The fact that there are multiple TAs keeps the load manageable for everyone.

If *students* are asked to generate content [15] (e.g., worked examples, homework/test questions), a large class can provide a lot more usable material. Common misconceptions become apparent far more quickly, so the instructor can design multiple-choice distractors to call them out, and draft specialized feedback on why each misconception is incorrect.

It's much easier to do statistically valid **research** with a control group and an experimental group in the same class. This bypasses the confounding issue that "it was a different semester with a different instructor, but we also added an intervention …" On subjective questions, the TAs' grades can be compared with each other, allowing the instructor to identify and correct grader bias and rubric ambiguity. One respondent, who teaches 150 to 250 students, says his class has been used in several research studies.

Finally, there is a phenomenon we might call the **performance effect**. Musicians are familiar with the motivating impact of a large audience. Garnett [16] relates, "A full house seems to bring with it a sense of occasion that encourages performers to step up to the mark and do their stuff more extrovertly, with greater panache. A sparse smattering of listeners seems to sap the spirit very slightly, and a performance that is just as thoroughly prepared and technically competent can feel like it lacks a little something." The same effect can be seen in a large classroom (called a "lecture theater" in many parts of the English-speaking world). Wolfman compares it to "the madness of crowds": enthusiasm "magnified by the scale of the large classroom … energizes students toward an activity" [17].

Two examples were cited by the author's respondents. "… I found that teaching a super-sized lecture was good motivation for me to think harder about my teaching - I knew I couldn't teach it the same way I teach small classes so I had to look for techniques I might never have thought to use otherwise (e.g., I started using clickers which led me to realize that electronic response systems have huge benefits over the index cards I used in smaller classes)." Another wrote, "Larger classes also can have much more energy and of course, more ideas. If I'm running around my physiology class asking students and student teams for their reasons why (for example) they voted to live without a stomach vs. without a large intestine or vice versa, they are bursting with reasons, ideas, questions, and relevant personal/family experiences, so I think the discussion is much richer and I think more engaging in my class of 90 versus a class of 25. .... Students have said the class is 'like a cup of coffee in the morning,' and I think it would be harder to create that 'caffeinated' environment with a smaller class."

5. A class is what you make of it

Of course, it will be difficult or impossible to arrange as much personal contact between faculty and students in a large class as in a small one. But student satisfaction isn't *necessarily* lower; both cited studies [5, 6] reported that the correlation between class size and student evaluations was extremely weak, non-monotonic, and not present in all departments. On balance, studies

Table 1. Summary of Strengths of Large Classes

Benefits for students

- **Community**: A large class can grow into a supportive learning community.
- **Diversity**: A large class likely consists of a diverse set of students and staff.
- **Competition**: Oustanding students are pushed to their peak by their peers.
- **Dissemination of good teaching** to a wider audience.

Benefits for staff

- **Earn more teaching credit**, focus on fewer courses.
- **Recruit students** for research and independent studies.
- **Professional development**: management experience for teaching assistants

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Benefits for both students and staff

- **Specialization:** TAs have their own niches, cover for each other.
- **Assessment:** Easier to set up automated feedback tools, learn from surveying students.
- **Content generation:** TAs, even students, generate assignments & other teaching materials
- **Research:** more subjects → more statistical significance
- **Performance effect:** More motivating to get up in front of a larger audience

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show no consistent relationship between class size and student achievement [18], even though grades tend to be lower in large classes [4].

Moreover, active-learning strategies can counteract the depersonalizing aspects of large classes. According to one large study [19], peer instruction, where much of the class is decentralized into small group discussions, not only improves student-satisfaction scores, but those scores fall off less as class size increases. Michaelsen [20] reported that when he surveyed students in a large class using Team-Based Learning, they thought that the large class size helped, not hindered their learning. Another study [21] found that cooperative learning techniques eliminated the satisfaction gap between small and large courses. In some kinds of courses, case-discussion methods offer the same benefits [22].

In the final analysis, it's all about attitude. Small courses have one set of advantages, and large courses have another. An instructor who disdains teaching large classes is unlikely to have much success doing so. But a faculty member who is prepared to capitalize on the opportunities they offer will be able to touch many more students' lives than in small courses. As Wolfman [17] concluded, "One overarching lesson was that *a positive outlook on large lecture courses helps keep the* instructor *positive about his course.*"

References

1. Bligh, D. A. *What's the use of lectures?* San Francisco: Jossey-Bass Publishers, 2000.

2. Gibbs, G. *Improving the quality of student learning*. Bristol, UK: Technical and Educational Services, 1992.

3. Gibbs, Graham, Lisa Lucas, and Vanessa Simonite. "Class size and student performance: 1984–94." *Studies in higher education* 21, no. 3 (1996): 261-273.

4. Kokkelenberg, Edward C., Michael Dillon, and Sean M. Christy. "The effects of class size on student grades at a public university." *Economics of Education Review* 27, no. 2 (2008): 221-233.

5. Fernandez, Juan, Miguel A. Mateo, and Jose Muniz. "Is there a relationship between class size and student ratings of teaching quality? " *Educational and Psychological Measurement* 58, no. 4 (1998): 596-604.

6. Gannaway, Deanne, Teegan Green, and Patricie Mertova. "So how big is big? Investigating the impact of class size on ratings in student evaluation." *Assessment & Evaluation in Higher Education* 43, no. 2 (2018): 175-184.

7. Edward F. Gehringer, "Optimizing your teaching load," ASEE Annual Conference and Exposition, Indianapolis, June 15–18, 2014.

8. Lynch, Rosealie P., and Eric Pappas. "A Model for Teaching Large Classes: Facilitating a "Small Class Feel"." *International Journal of Higher Education* 6, no. 2 (2017): 199.

9. Goff, Richard, Janis Terpenny, and Terry Wildman. "Improving learning and engagement for students in large classes." In *2007 37th Annual Frontiers In Education Conference*, pp. S3D-16. IEEE, 2007.

10. Takacs, Christopher G., and Daniel F. Chambliss. *How College Works*. Harvard University Press, 2013.

11. Edward F. Gehringer, "Using independent-study projects in your research and teaching program," 2007 ASEE Annual Conference and Exposition, American Society for Engineering Education, Honolulu, HI, June 24–27, 2007.

12. Edward F. Gehringer, "A course as ecosystem: melding teaching, research, and practice," ASEE Annual Conference and Exposition, American Society for Engineering Education, Montreal, QC, June 21–24, 2020, paper #30235

13. Edward F. Gehringer, "Daily course evaluation with Google forms," ASEE Annual Conference and Exposition, American Society for Engineering Education, Louisville, KY, June 20–23, 2010, paper #2010-1151.

14. Edward F. Gehringer and Barry W. Peddycord III, "Teaching strategies when students have access to solution manuals," ASEE 2013 Annual Conference and Exposition, Atlanta, June 23–26, 2013.

15. Zare, Richard N., Charles T. Cox Jr, Katherine Murphy, and Camille Bayas. "Implementation of Peer-Reviewed Homework Assignments." *Journal of College Science Teaching* 46, no. 3 (2017), pp. 40-46.

16. Garnett, Liz. "Why do we perform better to a bigger audience?" *Helping You Harmonize* blog, July 25, 2010, https://www.helpingyouharmonise.com/bigaudience

17. Wolfman, Steven A. "Making lemonade: Exploring the bright side of large lecture classes." In *Proc. 33rd SIGCSE Technical Symposium on Computer Science Education*, *ACM SIGCSE* Bulletin, vol. 34, no. 1, 257-261. ACM, 2002.

18. Williams, David D., Paul F. Cook, Bill Quinn, and Randall P. Jensen. "University class size: Is smaller better?" *Research in Higher Education* 23, no. 3 (1985): 307-318.

19. Liao, Soohyun Nam, William G. Griswold, and Leo Porter. "Impact of Class Size on Student Evaluations for Traditional and Peer Instruction Classrooms." In *Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education*, pp. 375-380. ACM, 2017.

20. Michaelsen, Larry K., Arlettea Bauman Knight, L. Dee Fink (eds.), *Team-Based Learning: A Transformative Use of Small Groups in College Teaching*, Stylus Publishing, 2004.

21. Emerson, Tisha LN, Linda K. English, and KimMarie McGoldrick. "The High Costs of Large Enrollment Classes: Can Cooperative Learning Help? " *Eastern Economic Journal* 44, no. 3 (2018): 455-474.

22. Harding, Lora Mitchell. "Keeping Goliath on his toes: a case-discussion method for increasing engagement and individual accountability in large classes." *Marketing Education Review* 28, no. 2 (2018): 131-135.