# Special Session - Enhancing Student Learning Using SCALE-UP Format

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*Abstract* - **SCALE-UP (Student-Centered Activities for Large Enrollment Undergraduate Programs) is a specialized active learning format that relies largely upon social interaction among students, instructor, and learning assistants. The instructor and learning assistants serve as facilitators of guided inquiry by asking students leading questions as they work through class assignments. On-going, real time formative assessments ensure that the instructor is constantly aware of which students are mastering the material and which are struggling. The SCALE-UP format is currently used at our institution in the General Engineering program (all sections of the first year courses), Math Sciences (all sections of first year calculus, and one section of second year calculus), Civil Engineering (one section of engineering statics), Mechanical Engineering (all sections of engineering statics and dynamics), as well as in courses in Horticulture, Nursing, English, and Computer Science. This special session focuses on strategies for successful implementation of this pedagogical innovation. These include development of student activities, formative assessments, training for instructors and learning assistants, and the physical features of the learning environment.**

*Index Terms* – Active learning, collaborative learning, guided inquiry.

## OVERVIEW

SCALE-UP (Student-Centered Activities for Large Enrollment Undergraduate Programs) originated at North Carolina State University in the Physics Education Research and Development Group. The SCALE-UP format has these essential components:

- Mini-lectures, which replace full period lectures.
- High engagement learning activities: discovery learning, inquiry-based learning, and cooperative learning
- Student tables that provide power and network for student laptops or tablets (typically seven foot round tables seating three teams of three).
- Formative assessment by the instructor and one or more learning assistants during the learning activities.
- Rich social interactions that develop a community of learners.

In a student-centered course, students take responsibility for mastery of the learning objectives. If the supporting material for a learning objective is not "written on the board" students are still responsible for mastery. It is an axiom of the SCALE-UP format that mastery is often better supported by activities other than lecture.

## THE SCALE-UP ENVIRONMENT

We provide academic instruction to groups of up to 72 students, with a ratio of instructor (or learning assistant) of approximately 1:24. The students are seated eight or nine to a table, providing two to three teams of three to four students each. The instructor is located at the center of the room, no longer at the front of the classroom; in fact, a SCALE-UP classroom has no real "front" at all. Movable seating allows students to adjust the layout of their workspace and each student group is accessible to the instructor. Multiple projection screens are visible from any seat in the room. Each group of four students in the room has a collaborative workspace in the form of whiteboards surrounding the perimeter of the room. In addition, the instructor has access to a Sympodium tablet to use in place of the traditional chalkboard.

While SCALE-UP can be used in standard 50-minute classes, we have applied it successfully in extended period classes (up to 2.5 hours). A typical class period consists of a short lecture to review the expected reading materials and expand upon the topic giving alternate examples and explanations not found in the written text. Depending upon the topic and progression of the semester, these lectures can range from as long as 30 minutes during the first few weeks of the semester to as little as 10 minutes to simply introduce the topic, activities and goals for the day.

After lecture, the students work on learning activities for the remainder of the period. The instructor and learning assistants circulate to provide guidance throughout the activities. Students usually start out a learning activity by grappling with it individually, then moving towards peer interactions to work through the problem. Pairs or groups come to a consensus on the approach and correct answers. Formative assessment takes place through observations by the instructor and UTAs of student interactions, approaches to problem solving, and questions. When student questions reveal that many students are struggling with the same point, the instructor will sometimes choose to briefly return to lecture mode.

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Students are encouraged to use collaboration to learn from each other, but are ultimately responsible for their own work. There are many benefits to collaborative learning, especially ensuring that students are never without help [2]. Homework assignments are designed to reinforce and expand on the learning activities. Because students wrestle with, and ultimately complete, activities during class with the benefit of the instructors and peers, they are able to work on homework with the confidence that they understand the material.

A common concern about adopting this type of learning environment is that not as much material is covered since class time is used to complete activities. Our experience is that the same amount of material is taught as in traditional lecture format courses. While fewer example problems may be worked by the instructor, students benefit more by solving a problem with immediate assistance if needed, than from watching someone else work a problem with little opportunity for real input into the solution process [3]. In addition, an instructor can quickly assess their understanding of the material based on on-going formative assessments. These observations are supported by data on improved student performance in SCALE-UP courses as well as in follow-on courses in some cases [4]. Anecdotal evidence supports the strengthening of teaming and communication skills for students who have been taught in this environment in two or more courses.

## SPECIAL SESSION CONTENT

Participants in this session will be lead through a lesson taught in SCALE-UP format, to illustrate the teaching and learning contexts of SCALE-UP. The lesson will teach a specific concept in engineering, such as heat transfer, using skills and concepts that are common to other disciplines (observation, taking measurements, predicting, graphing, and drawing conclusions). In teams of 2 - 3, participants will be given a challenge question, specific criteria for answering it, and materials for setting up a simple experiment. Each team will "report out" on its findings to the rest of the participants. Participants will then have the opportunity to make observations about how the lesson was conducted, challenges and opportunities with guided inquiry, collaborative learning, and active learning, and ask questions about adapting the SCALE-UP format to a variety of disciplines.

Working in groups from similar disciplines, participants will be asked to outline a collaborative, hands-on classroom activity that they could apply in a current or future course. They will create posters to illustrate their ideas, and share them with other session participants. Upon completion of this workshop, participants will be able to:

- plan a SCALE-UP lesson
- guide activities during class periods
- maximize the effectiveness of learning assistants
- assess student learning during class periods

Participants will receive a hand-out with the essential components of a SCALE-UP lesson, a comprehensive bibliography of resources for active and collaborative learning, suggestions for adapting traditional lessons to SCALE-UP, and objectives for assessing learning.

## REFERENCES

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