Student-Centered Learning Addressing Faculty Questions about Student-centered Learning

Jeffrey Froyd, Nancy Simpson

Texas A&M University

What is meant by Student-centered Learning (SCL)?

A variety of phrases have been coined to describe a critical shift in mission and purpose of higher education. Barr and Tagg (1995) expressed the change as a move from an "Instruction Paradigm" in which universities delivered instruction to "transfer knowledge from faculty to students" to a "Learning Paradigm" in which universities produce learning through "student discovery and construction of knowledge." Huba and Freed (2000) used the phrase "learning-centered assessment" to emphasize transition in the focus of instruction and assessment from teaching to learning. The following description of student-centered instruction provides another starting point for conversations about student-centered learning:

> *Student-centered instruction [SCI] is an instructional approach in which students influence the content, activities, materials, and pace of learning. This learning model places the student (learner) in the center of the learning process. The instructor provides students with opportunities to learn independently and from one another and coaches them in the skills they need to do so effectively. The SCI approach includes such techniques as substituting active learning experiences for lectures, assigning open-ended problems and problems requiring critical or creative thinking that cannot be solved by following text examples, involving students in simulations and role plays, and using self-paced and/or cooperative (team-based) learning. Properly implemented SCI can lead to increased motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes towards the subject being taught (Collins & O'Brien, 2003).*

Student-centered learning can also be viewed from the perspective of an influential report from the National Research Council (1999) that synthesized research on learning and recommended organizing learning environments around four foci: knowledge-centered, learner-centered, assessment-centered, and community-centered. Knowledge-centered learning approaches grow out of the research on novices and experts that has revealed that experts have organized their knowledge very differently than novices. So knowledge-centered learning stresses learners developing their knowledge to facilitate transfer of their learning to new contexts and application of their learning to open-ended challenges such as problem-solving, critical thinking, and design. In a learner-centered learning environment, McCombs and Whistler (1997) state that "learners are treated as co-creators in the learning process, as individuals with ideas and issues that deserve attention and consideration." Learner-centered learning environments recognize that the prior knowledge of learners powerfully influences future learning and thus attempt to build on prior knowledge. Assessment-centered learning environments provide opportunities for feedback and improvement throughout the learning process leading to evaluation and judgment at the end of

the learning process. Assessment for feedback and improvement is referred to as formative assessment while assessment for conclusive evaluation and judgment is referred to as summative assessment. Nicol and Macfarlane-Dick (2006) indicate that formative assessment can promote the development of capacities and attitudes used in lifelong learning. Assessment-centered learning environments also emphasize congruence between learning goals and what is assessed (National Research Council, 1999). Finally, community-centered environments recognize that individual learners take many cues and insights from learners around them, so that community-centered learning environments facilitate purposeful interactions among learners to promote and sustain learning. For the purposes of this essay, learning environments are student-centered to the degree to which they are concurrently knowledge-centered, learner-centered, assessment-centered, and community-centered.

Many different faculty members have developed and used approaches to teaching that fit the criteria for student-centered learning. Many of these developers have created original names for their approaches. As a result, there is a broad spectrum of named approaches, which include

- Active Learning (Bonwell & Eison, 1991)
- Collaborative Learning (Bruffee, 1984)
- Inquiry-based Learning
- Cooperative Learning (Johnson, Johnson, & Smith, 1991)
- Problem-based Learning
- Peer Led Team Learning (Tien, Roth, & Kampmeier, 2001)
- Team-based Learning (Michaelson, Knight, & Fink, 2004)
- Peer Instruction (Mazur, 1997)
- Inquiry Guided Learning
- Just-in-Time Teaching
- Small Group Learning
- Project-based Learning
- Question-directed Instruction

Faculty members often have many questions about student-centered learning approaches and implications for how they might teach. Several of these questions will be addressed in this document:

- Why would you adopt a student-centered learning approach in your course?
- Can I cover the content in my syllabus using student-centered learning approaches?
- Can I use student-centered learning approaches when teaching large classes?
- Is it possible to move from teacher-centered to student-centered in stages? How?
- How do I respond to student resistance when I start using student-centered learning approaches?
- How do I respond to students who really like being entrusted with their own learning when I start using student-centered learning approaches?

Also, many student-centered learning approaches involve faculty forming students into small groups or teams for learning activities. Prospects of working with student teams raise another set of questions, which are addressed in the last portion of the document.

- How should I form the teams?
- How do I get teams off to a good start?

- How do I grade team assignments?
- How can I help students develop their teamwork capabilities?

Why might I adopt a student-centered learning approach in your course?

Although there are many different reasons why faculty members choose to adopt a student-centered learning approach, they might be placed into two broad categories. First, it is enjoyable. Faculty members who have adopted one or more of these approaches report that they are energized. Second, there is a growing set of results on how these approaches lead to improved student learning.

Student-centered Approaches to Learning are Enjoyable

Faculty members from across the nation (who teach both large and small classes) who have adopted a student-centered learning approach find that teaching is more enjoyable. Some of their stories are available at web site created by the Foundation Coalition and at web site created by the National Institute for Science Education – College Level One. Through interviews, faculty members talk about how they changed their teaching and how their attitudes to teaching have changed.

What does research say about student-centered learning?

Do student-centered learning approaches lead to improvements in student performance? Results from a growing number of studies indicate that the answer is yes. For more details on these studies the Center for Teaching Excellence at Texas A&M University is compiling a bibliography of papers that demonstrates student-centered learning approaches lead to measurable improvements. Some of the papers are meta-analyses that synthesize results from numerous individual studies. These results confirm positive influences of student-centered learning approaches to teaching on academic performance, attitudes toward learning, and persistence in programs. In light of the growing evidence of on the effectiveness of student-centered learning approaches, Handelsman et al (2004), in an article in *Science*, stated "There is mounting evidence that supplementing or replacing lectures with active learning strategies and engaging students in discovery and scientific process improves learning and knowledge retention."

Can I cover the content in my syllabus using student-centered learning approaches?

Although faculty members may find student-centered learning approaches to be more enjoyable and lead to improved student learning, they still have questions about the amount of content that can be covered using the approaches (J. L. Cooper, MacGregor, Smith, & Robinson, 2000; M. M. Cooper, 1995; Felder & Brent, 1999; Tien et al., 2001). Content coverage is still high priority for faculty members, especially for faculty members teaching prerequisite courses on which faculty members teaching downstream courses are depending for student preparation. Answers to whether faculty members can cover the same or more content with student-centered learning approaches as can be covered with traditional lecture-based approaches depend on individual teachers. Although some teachers indicate that they cover as much or most content with student-

centered learning approaches, some adopters of student-centered learning approaches indicate that they now cover less content than when they exclusively lectured, but that students are learning more. For example, as indicated in the research summaries of The Active Learning Site, Ruhl, Hughes and Schloss (1987) showed that students in courses in which faculty members paused at intervals and talked six minutes less performed significantly better on the same exam than students in courses where faculty lectured the entire time. For faculty members who are interested in learning more about how to cover the same or more material with student-based learning approaches, the following resources offer well-tested ideas:

- Richard Felder and Rebecca Brent have addressed this question many times in workshops on effective teaching. In the first half of this column (Felder & Brent, 1999) they offer a summary of their response.
- In an article, Cooper, MacGregor, Smith, and Robinson (2000) address several questions or concerns that faculty members have raised about small-group learning. The first question that they address in their article is about content coverage. "The faculty members we interviewed expressed consistent satisfaction that students in their classes are demonstrating one or more of these indicators of increased learning: much greater conceptual understanding, more complex critical-thinking skills, better class attendance, more independence in lab settings, and greater confidence. About two-thirds of the faculty members we interviewed said that they covered fewer topics in class when they used group work, but that students learned and retained more of the "big ideas" that they chose to address relative to using lecture formats." Answers to other questions provide approaches that faculty members have used to adapt student-centered learning approaches for their courses.

Can I use student-centered learning approaches when teaching large classes?

- Cooper and Robinson (2000) offer strategies for using informal (students working in small groups for short periods of time) small-groups in large classes. Strategies include: think-pair-share (Lynam, 1981), peer instruction (Mazur, 1997), Quick-thinks (Johnston & Cooper, 1997), and minute papers (Angelo & Cross, 1993; Stead, 2005).
- After faculty member are comfortable with informal strategies, they might consider moving to formal strategies described by Smith (2000). Implementation of these strategies requires more advanced preparation, but can move students toward accepting more of the responsibility for their learning and lead to the development of greater capabilities for lifelong learning.
- Participants in workshops by Felder and Brent have raised this question frequently. In the second half of their column (Felder & Brent, 1999) they offer a summary of their response. They indicate that it is important to limit each interactive activity to its predetermined time limit and select students to share some conclusion or result from their work.
- Allen and Tanner (2005) offer a set of seven strategies that have been applied in large enrollment biology courses.
- Michaelsen, Knight and Fink (2004) offer examples of team-based learning in large classes.

Can I move from teacher-centered to student-centered in stages? How?

First, using student-centered learning approaches to teaching never means that teachers do not lecture. Next, slow, thoughtful, reflective transitions to student-centered learning approaches are likely to lead to the most sustainable changes in teaching. Faculty members might begin with informal cooperative learning approaches: think-pair-share (Lynam, 1981), Quick-thinks (Johnston & Cooper, 1997), and minute papers (Angelo & Cross, 1993; Stead, 2005). Here are possible directions:

- They might consider using a small number of the approaches listed on the "Engaging Students Tip Sheet" [include sheet prepared by Jean Layne].
- They might consider using a few informal cooperative learning structures (J. L. Cooper & Robinson, 2000) for engaging their students for short period of time after lecturing for a portion of a class. Informal cooperative learning structures include:
  - **Think-Pair-Share**: Ask students to think individually about a question for about a minute, turn to a neighbor and exchange ideas, and then randomly select a small number of students to share both ideas (Lynam, 1981). Instead of pairs, you can use groups of 3 or 4.
  - **Roundtable:** Ask a group of students a question. First student writes and share her/his answer, passes to second student, and so on.
  - **Minute Papers:** Ask students to address two questions at the conclusion of a lecture segment or a class. The first question is about what they thought was clearest or most significant. The second question is about what they still have questions about (Angelo & Cross, 1993; Stead, 2005).
- Allen and Tanner (2005) recognize that "moving out from behind the relative safety of the lecture podium to adopt the types of active strategies that shift classroom emphasis away from teachers' teaching toward students' participation and learning is often an unsettling prospect, even in the small-class setting." Therefore, they have assembled a set of seven strategies, ranging from simple, easily implemented approaches to complex restructurings of the entire course.
  - **Bookend Lectures:** Faculty members can insert short interactive sessions (think-pair-share, student writing) after every 10-20 minute lecture session (Bonwell & Eison, 1991; Ruhl et al., 1987). If they begin with an advance organizer and finish with a classroom assessment technique, such as a minute paper, they create a bookend lecture (Smith, Sheppard, Johnson, & Johnson, 2005).
  - **Immediate Feedback via Classroom Technology:** Various technologies from scratchable scantran sheets (Allen & Tanner, 2005) to personal response systems ("clickers") (Fies & Marshall, 2006) can be used to provide students immediate feedback through questions on their preparation for class or concepts that arise during class.
  - **Student Presentations and Projects:** Faculty members can assign projects and reports to actively engage students in explorations of the course material.
  - **Learning Cycle Instructional Models:** Faculty members can use different learning cycles to construct classes that move students through a sequence of questions about the material in a class (Why, What, How, and What if) (Harb, Durrant, & Terry,

1991). See Ebert-May et al (1997) for a model that moves students through engagement, exploration, explanation, elaboration, and evaluation.

- **Peer-Led Team Learning (PLTL):** Undergraduate students can facilitate one or more cooperative learning groups in course to guide exploration of problem solving, inquiry, or discovery (The Peer-Led Team Learning Workshop Project, nd).
- **Incorporating Inquiry into Courses**
- **Problem-Based Learning and Case Studies**

As you develop comfort with a small set of approaches, expand your set. Consider a more involved activity, e.g., a jigsaw or extended project in which you prepare students to work more effectively as a team and manage the project over the time you have allocated.

How do I respond to student resistance when I start using student-centered learning approaches?

Since you will be asking learners in your class to behave differently, you should expect some resistance, since all humans tend to resist requests for changes. So anticipate some resistance and be prepared to address the resistance constructively. Explain to students why you have chosen to adopt these approaches and how you think it will benefit them. It may be helpful to indicate that you will be providing opportunities for their input and will respond to their ideas. Here are some suggestions:

- Felder and Brent acknowledge some of the bumps in an article, Navigating the Bumpy Road to Student-Centered Instruction (Felder & Brent, 1996) and offer ways they have found to address these.
- One of the questions that Cooper, MacGregor, Smith, and Robinson (2000) address is student resistance: "The faculty members we interviewed indicated that initial resistance among students generally focused on prior bad experiences with poorly planned and executed group work in high school and college." They offer some strategies based on their interviews with faculty members: clarify changing expectations before and during implement of new strategies, create meaningful activities that encourage students to process information in different ways and yet that are at an appropriate level of difficulty and complexity, and clarify expectations for each learning activity.
- Keeney-Kennicutt, Gunersel, and Simpson (2008) studied an implementation of Calibrated Peer Review, a web-based program that supports peer review of student papers following an exercise in which students calibrate their assessment of faculty-generated examples. They uncovered student reasons for liking and disliking the innovation and documented instructor modifications to address resistance.

How do I respond to students who really like being entrusted with their own learning when I start using student-centered learning approaches?

The need for learning how to learn is becoming more widely recognized from many different directions. It may be helpful to provide resources to these students that affirm and reinforce their inclination to initially accept responsibility for their own learning:

- Accreditation mandates have brought to the forefront the need to be "life-long learners" in the ever-changing and evolving engineering profession, coupled with the fast changing

technologies and the need to accommodate a global society (Marra, Camplese, & Litzinger, 1999).

- "A new class within the workforce has been identified as 'knowledge workers'…the key knowledge workers are engineers…Engineers must continually learn in order to stay abreast of the technologies that impact their jobs" (Wells & Langenfeld, 1999).
- "The half-life of an engineer's technical skills is 2.5-7.5 years, depending on your discipline. This means that the vast majority of the technology that will exist in the latter part of a 40-year career has not yet been developed…During an engineer's career, he/she will develop some of this new technology. New tools and techniques will be used in daily work. Employers expect engineers to either learn this new information on their own or to find someone who can teach it to them" (Todd, 2001). Other information on the rate of growth of scientific and engineering knowledge can be found in (Wright, 1999).
- "Finally it should be acknowledged that the greatest motivation for learning is learning itself. If a student can make the transition from extrinsic rewards (recognition, grades, etc.) to intrinsic rewards, then the basis for lifelong learning will have been established. In engineering, there is a joy of learning that is associated with knowing and predicting how the world works. Students need to have opportunities to experience this" (Parkinson, 1999).

Given the importance of attitudes and capabilities for lifelong learning, students who have accepted greater responsibility for their own learning, which is inherent in any student-centered learning approach, have made an important step in their intellectual development. Faculty members can work with students to raise deeper questions about how they learn and how they can adjust to facilitate their own learning. Kornell and Bjork (2007) raise key decisions that learners must make about their own learning and how they need more accurate pictures of how they learn.

Facilitating Small Groups

Many of the student-centered learning approaches have students participating in small groups in class, and in some cases, out of class. Often, students do not have the knowledge and skills to work effectively in groups. However, if prompted, they are familiar with problems that can arise when working in groups and they have some ideas about how to address these situations. Here are some of the questions that faculty members often ask about using small groups or teams as part of an approach to teaching.

How should I form the teams?

The faculty member has the primary, but not the only, responsibility for creating a safe, productive learning environment. In general, the teams that are formed influence the learning environment that is created. As a result, the faculty member has the responsibility for forming teams. For additional resources and ideas on forming teams, see

- The Foundation Coalition created a resource, Forming Student Teams, that addresses questions about team size and offers strategies for forming teams that faculty members have used in their courses.
- In Effective Strategies for Cooperative Learning, Richard Felder and Rebecca Brent offer some strategies for forming teams

- The Student-Centered Activities for Large Enrollment Undergraduate Programs (SCALE-UP) Project has written a peer-reviewed book chapter, The Student-Centered Activities for Large Enrollment Undergraduate Programs (SCALE-UP) Project, in which physics faculty members from several different institutions share their insights for forming teams
- Larry Michaelson offers strategies for forming teams in a primer, Getting Started with Team Learning. The primer contains information on forming teams. More information about his approach to Team-Based Learning can be found in his book, *Team-Based Learning: A Transformative Use of Small Groups in College Teaching*, and a summary, Building Learning Teams: The Key to Harnessing the Power of Small Groups in Higher Education, by Michaelson and Block.

How do I get teams off to a good start?

Most college students do not have the knowledge and have not developed their capabilities to function effectively on a student team. Therefore, faculty members must work to establish a learning environment that supports effective student teams. Many of the challenges that occur when using student teams can most effectively be addressed at the beginning of the course. Here is when student teams can identify potential concerns, including possible leader and participant issues, and develop norms of behavior through which these concerns can be addressed. Here is when the teacher can set out policies for addressing problems which may occur downstream. Here is when the teacher can lay out evaluation policies that will address grading team assignments.

- The Foundation Coalition created a resource, Helping Teams Off to a Good Start.
- National Institute for Science Education - College Level One: Innovations in Science, Math, Engineering, and Technology Education offers an annotated bibliography, stories from teachers using collaborative learning, and a set of strategies that have been used for collaborative learning.
- Information Technology Services at Penn State University offers solid guidelines and activities to offer a solid foundation for future teamwork
- ??Tim Peterson would be a good resource for more here.

How do I grade team assignments?

Giving every team member the same grade on a single assignment submitted as a team does not promote individual accountability one of the core elements of effective cooperative learning. For faculty members looking for alternatives, consider the following resources.

- Karl Smith offers the following suggestions to promote individual accountability: (i) keep group size small, (ii) assign roles, (iii) randomly ask one member of the group to explain the learning, (iv) have students do work before group meets, (v) have students use their group learning to do an individual task afterward, (vi) everyone signs: “I participated, I agree, and I can explain the information”, and (vii) observe and record individual contributions.
- Peer assessment, in which team members offer data to help discern and evaluate individual contributions, is one approach to differentiating grades. The Foundation Coalition offers a resource on peer assessment and a resource on monitoring the progress of student teams on extended team assignments.

- The Office of Educational Development at the University of North Carolina offers a resource on developing effective student team exercises.
- Positive Interdependence, Individual Accountability, and Promotive Interaction offers guidelines to incorporate these three essential elements into developing team activities.

How can I help students develop their teamwork capabilities?

Faculty members have a tremendous opportunity to help their students develop an important set of skills that will be needed throughout their lives.

- Information Technology Services at Penn State University offers a suite of resources to help faculty members support the development of capabilities needed for effective teamwork.
- The Foundation Coalition offers resources on conflict management and resolution, communication within a team, and decision making within a team framework.
- Building Engineering Student Team Effectiveness and Management Systems (BESTEAMS) offers a set of resources for working with student teams

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