Constructive Academic Controversy- What is It? Why Use It? How to Structure It?

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***Abstract* – Constructive Academic Controversy has been available as part of the repertoire of engineering faculty since the early 80s. In this paper we strive to update and revitalize the approach through: 1) reviewing the development of Academic Constructive Controversy including the benefits of this type of cooperative learning approach, 2) providing instructional references and resources, and 3) reviewing current case examples in both engineering and engineering education classrooms.**

Index Terms – cooperative learning, constructive academic controversy

WHAT IS CONSTRUCTIVE ACADEMIC CONTROVERSY?

Conflict is natural. Think of the hierarchal structures of wolf packs where initiating and resolving conflict establishes order within the pack. Conflict is interesting. In primary schooling we are taught that the elements of a good story include conflict and resolution. Conflict; however, is often avoided in instructional settings We argue that addressing and striving to resolve conflict can be a powerful learning experience. Constructive Academic Controversy (CAC) harnesses the power of conflict into a cooperative learning activity. David Johnson, Roger Johnson and Karl Smith [1], longtime researchers, practitioners and facilitators of cooperative learning and specifically CAC, provide the following definition:

> "Constructive [academic] controversy is an instructional procedure that combines cooperative learning (in which students work together in small groups to develop a report on an assigned topic, for example) with structured intellectual conflict (in which students argue the pro and con positions on an issue in order to stimulate problem-solving and reasoned judgment." (p. 30)

They promote CAC as a way for students to actively engage in developing a deep understanding of a topic.

CAC can be used to explore any topic for which there are multiple perspectives, typically pro and con. Briefly, the steps of CAC include:

1. Students are assigned to groups of four and into pairs within those groups. The group is given an assignment (joint report, classroom presentation, public dialogue, etc.) to be completed together. One pair is initially assigned the pro position and the other pair the con position. However, in the end they are required to reach a mutually agreeable conclusion, which may be a summary of the best arguments on all sides.
2. Each pair of students researches the issue and prepares arguments for their position. They engage with the other pair in their group presenting, defending and refuting arguments.
3. The pairs reverse perspectives and continue engagement on the assigned topic.
4. Together the pairs synthesize arguments and reach a common resolution.

Instructors monitor the process insuring students engage intellectually and respectfully in the process. Several instructional references describe this process in greater detail [1-3].

WHAT IS THE HISTORY OF CONSTRUCTIVE ACADEMIC CONTROVERSY IN ENGINEERING EDUCATION?

Constructive Academic Controversy was introduced to the engineering education community at the 1982 FIE Conference [4]. It was received with a lot of interest due, in part to the strong theoretical support and the growing body of empirical evidence. A 1982 FIE workshop by Johnson and Smith [5] won the Helen Plants Award for the best non-traditional session. At about this time Greenhaven Press introduced their Opposing Viewpoints series, which provided additional resources. Smith continued to make extensive use of the approach in his civil engineering courses, especially around environmental controversies; in College of Liberal Arts Honors Seminars and Colloquia, and through today in his graduate courses. A few faculty adopted the approach including, for example, Tom Lord a biology professor at Indiana University Pennsylvania (Cited in [6])

WHY USE CONSTRUCTIVE ACADEMIC CONTROVERSY IN ENGINEERING CLASSROOMS?

Current ABET [7] criteria include requirements for programs to graduate students:

- who can function on multidisciplinary teams,
- who can communicate effectively, and
- who are educated sufficiently broadly to understand how engineering solutions have impact in global, economic, environmental and societal context.

ABET specifies these criteria as outcome-based measures of success without specifying how these criteria should be met. CAC can help students develop these skills.

But what do we really mean by teamwork, communication, and understanding broader impacts? We want our students to be able to contribute to team discussions and negotiations while solving engineering problems. We want our students to develop and articulate positions on issues. We want our students to recognize that there can be multiple stakeholders and to reflectively consider the argument positions represented by these others. We want our students to respectfully and successfully navigate differences of opinion and conflict within groups. These are all skills students can learn through participation in CAC.

Learning such skillful disagreement is a key benefit of CAC. Based on Rules for Controversy [3], skillful disagreement includes an approach to problem-solving involving:

- Defining the decision as a mutual problem, not as a win-lose situation
- Being critical of ideas, not of people
- Separating one's personal worth from others' reactions to one's ideas
- Differentiating thoughts and ideas before integrating them
- Take another person's perspectives before refuting their ideas, and
- Listen fairly to other's thoughts and ideas.

Fostering these skills in our students will prepare them for professional practice. As engineers, many of them will routinely engage in team-based problem-solving activities where the best solution will not always be the best technical solution but will be balanced across the concerns of a variety of stakeholders.

CAC teaches skills that are aligned with the desired attributes for the *Engineer of 2020* [8] including strong analytical skills, creativity and life-long learners. Empirical research shows CAC contributes to developing such attributes. Based on a meta-analysis comparing CAC to concurrence-seeking, debate and individualistic efforts, CAC leads to higher achievement, higher-level reasoning, increased creativity as measured by increased quality, quantity and range of ideas and arouses curiosity [1-3, 9].

The top two skills employers look for in new hires are teamwork skills and critical thinking/reasoning [10] and the CAC approach can help develop both.

How Can I Use Constructive Academic Controversy in My Classroom?

There are several comprehensive guides to CAC providing detailed instructions on using this technique in the classroom [1-3]. Several resources also address concerns relevant to college classrooms [11, 12]. Cooper and colleagues use both empirical and anecdotal interview evidence to address concerns that arise among practitioners considering using small-group cooperative learning strategies such as CAC [11]. The addressed concerns include such things as:

- Is content sacrificed?
- Do students learn as much in small groups?
- Do you have to teach students how to work in groups?
- Do students resist or colleagues judge negatively this type of learning approach?
- What are the logistics for a large class?
- How does grading work?

Following are some case study examples using CAC in engineering education classrooms.

Current Examples in Undergraduate Engineering

Our search of the literature did not reveal any publications or website describing the application of CAC in undergraduate engineering classes or programs despite our high hopes. We know from our experience that the approach is being used in the South Dakota School of Mines and Technology Center of Excellence for Advanced Manufacturing and Production (CAMP) program, but we did not find any archival documentation. We hope that during and after the conference we hear from faculty who are engaging their students in constructive controversies.

Current examples in Graduate Engineering Education

Karl makes extensive use of CAC in the project and knowledge management and leadership courses he teaches in two professional masters programs – Management of Technology and Infrastructure Systems Engineering – at the University of Minnesota; however in this paper we describe two recent applications of CAC in graduate level courses in the School of Engineering Education at Purdue University. Karl and Holly were both involved in each case.

Leadership, Policy and Change

In the spring semester of 2007 a course titled *Leadership, Policy and Change* was offered for the first time. Although offered through the College of Engineering, the course focused more broadly on Science, Technology, Engineering and Mathematics (STEM) fields. Holly was a student in this class and Karl was one of the instructors.

The course was divided into the three modules as suggested by the title, although the themes were integrated overall. The objectives for the policy portion of the class included examining current STEM educational policies, understanding how policies can impact stakeholders and gaining familiarity with policy implementation and analysis. As part of the policy module, students participated in CAC. This activity was consistent with the aforementioned goals of the policy module as well as the overall course goal of learning about negotiation strategies and change implementation.

The CAC activity was structured as both a homework and in-class group assignment. Individually students selected policy-related questions from an instructor-provided list of possible questions. Based on students' expressed interests, the instructors created teams of students. As an example of the topics, Holly's team argued the question "How serious a threat is globalization?"

Within the teams, the students self-divided into pairs. One pair adopted the pro position and one the con position. Outside of class, the pairs and teams met to share resources and prepare arguments. Ultimately, each pair prepared a pro and a con argument knowing they would ultimately present both sides. In class, each team participated in a CAC activity while the balance of the class observed.

In this application, CAC served as way to teach students about effective arguing within the setting of exploring policy. Students had the opportunity to actively engage with others to consider different stakeholder perspectives on the same issue.

History and Philosophy of Engineering Education

In the fall semester of 2007, a course titled History and *Philosophy of Engineering Education* was taught for the first time. Karl was one of the instructors and Holly was a faculty apprentice for this course.

Knowing that many of our students were future engineering educators and researchers, by design this course aimed to teach students content as well as promoting the deeper thinking and argument formation skills needed by researchers. Course objectives centered on understanding how to read and critically examine the arguments made by others and how to develop and articulate one's own arguments and perspectives. CAC was a good fit with these goals.

CAC was conducted as an in-class activity although students had readings related to the controversy topic as a homework assignment prior to the class. The topic related to a primary course theme, "What is engineering?"

On the day of the activity, we introduced students to CAC both as teaching tool by including some theory and benefits, and as a learning activity in which they would participate that day. The students were divided into groups of four. The groups of four were subdivided into pairs and each pair was assigned a pro or con position to argue initially. The students then watched a video clip of an engineering design team at work in a professional context. Students were instructed to make notes supporting the activities represented in the video as "engineering activity" (pro) or "not engineering activity" (con). At the conclusion of the video clip, the students began active CAC.

CAC provided students an opportunity to actively practice developing and articulating their own arguments while analyzing and responding to arguments made by their peers.

RECOMMENDATIONS

CAC has and can be used in classrooms with a variety of structures and to help students learn about any topic or issue that has multiple perspectives. There are several guides available for ACA and other cooperative learning strategies. Empirical evidence shows the benefits of CAC to students. CAC is aligned with ABET criteria and recommendations for engineers of the future. All of this evidence suggests that our engineering students can benefit from CAC. The question that remains is, can we afford not to use this learning strategy in our engineering classrooms for another 20 years?

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