

When Conflict Helps Learning

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Abstract

We describe techniques, implemented in a junior software engineering course, for creating an environment of safety and for regulating the amount of conflict so that students can learn how to use conflict to benefit their learning and the project instead of being overwhelmed or discouraged by it.

Intra-personal and inter-personal conflict, such as internal uncertainty, dissonance between one's desires and abilities, and perceptions of problems in other people, are inevitable in our lives and jobs. Learning to deal effectively with these conflicts is essential to becoming an effective engineer. This starts with realizing that there can be value in conflict. Conflict *motivates learning* because people do not like to repeat frustrating, embarrassing, or painful experiences. Conflict *inspires innovation* by illuminating areas of misunderstanding, invalid assumptions, personality or value differences that, when explored, can result in greater value to everyone involved.

To maximize learning, it is important to balance conflict with safety. Too much or the wrong type of conflict can be detrimental to learning. The techniques we used, some of them borrowed from professional leadership training programs, had a positive impact on the students, as revealed by their weekly reflective essays and by individual communication with them during and after the course. Students, perhaps subconsciously, created conflicts that enabled them to learn lessons they needed to learn.

One aspect of safety is how to limit the damage of mistakes while encouraging learning from mistakes. To that end, we chose not to have a real-world customer whose dependence on the project success would have increased the damage from a potential project failure. Our focus was on the learning – in the true spirit of academia – in order to prepare students for successful engineering careers.

1. Introduction

*Seeing conflict as an opportunity to create art from our very being is a challenge for the artist in all of us. Our lives are not dependent on whether or not we have conflict. It is what we do with conflict that makes the difference.*¹

Thomas F. Crum

The beneficial role of inner conflict in helping learning and as a source of innovation is not a new concept^{1,3}. However, it does appear to be an uncommon and thus a largely unadopted view

in academia. This paper discusses how inner conflict helps learning. We also provide a simple model with strategies how to create a course around this thesis and how to regulate the level of conflict in the course. We support our assertions with examples from a junior-level undergraduate software-engineering course taught at the University of Washington in 2002.

By conflict, we mean the inner feeling when, informally speaking, a person is not getting what they want. This is closest to Merriam-Webster's¹² definition 2b:

- 1: Fight, battle, war
- 2a: Competitive or opposing action of incompatibles: antagonistic state or action (as of divergent ideas, interests, or persons)
- 2b: Mental struggle resulting from incompatible or opposing needs, drives, wishes, or external or internal demands**
- 3: The opposition of persons or forces that gives rise to the dramatic action in a drama or fiction

Our thesis is that this type of inner conflict is an important part of how learning occurs. Inner conflict urges changes in behavior and thus helps us learn by making it too uncomfortable to not change old (behavioral) patterns.

This inner conflict is about a person's perception of the distance between their wishes and abilities. It is influenced by how much control they have over achieving their desires: the less control, the higher the perceived cost. The greater the cost, the more effort is required to get what they want, and thus the more intense conflict feels. Only when the cost of *not* changing is high enough will investing the effort and time to effect a change be worthwhile.

While "conflict" is a term loaded with negative connotations in our society, and some colleagues suggested using other terms such as "challenge" or "disequilibrium," we prefer to use "conflict" because that is how students *feel* when they are in the midst of it. However, it is a valuable tactic to change their assessment of a situation from "conflict" to more positively viewed notions such as "challenge" or "disequilibrium." This can reduce their stress level to a level that promotes learning. It transforms situations in which conflict is apparent and may be causing undue stress into learning opportunities. Once students realize that (temporary) chaos and internal conflict are necessary parts of learning, they become more comfortable being in those states and sometimes even welcome them. One of the goals of our course was to have students make this transition more quickly.

It can be difficult to notice when students experience inner conflict. While it was visible in some situations, we undoubtedly missed others. For this reason, we provided students with tools to help them detect their own inner conflicts. In some cases, especially in team environments, inner conflict can emerge as inter-personal conflict when a student finds it easier to put blame elsewhere than to change them self. In this case, dealing with the inner conflict would reduce the inter-personal conflict.

This paper describes a model for designing a course that uses the above interpretation of conflict. Student writings and conversations during the course and their feedback four months after the course indicate that while their conflict levels were sometimes high, many of the students valued

the experience and appear to have changed certain aspects of their behavior due to the course. Of the students that gave us feedback four months after the course, most have adopted several of the suggested techniques for effectively working in teams.

Next, Section 2 provides theoretical background on the role of conflict in learning. We describe the course design and our teaching goals in Section 3. Section 4 outlines models for classifying the strategies for a course that explicitly addresses the conflict inherent in experiential learning. Sections 5 through 7 briefly describe the strategies used in this course. Section 8 provides examples of how conflict influenced learning in our course. We conclude in Section 9.

2. The Role of Inner Conflict in Learning

While conflict could be harmful, it *is* part of our daily lives. It also is an important part of how people learn^{19, 4, 1}. Internal conflict indicates areas for learning and innovation by causing discomfort that, if severe enough, makes it worthwhile to try different ways of acting in the world. Changing behavior and not reverting to the old ways takes substantial effort and commitment, so there is good reason to not invest the effort to change unless the need is sufficiently high.

Once the insufficiency of the student's current models causes enough internal conflict to motivate change, the student starts actively (even if subconsciously) looking for new models to try. Such new cognitive models may come from peers or instructors, or the student may construct them as they struggle with the limitations of their existing models. Looking back over our lives, many of the most significant learning experiences we have had were ones that we constructed, usually in the course of some internal struggle. These were the "Aha!" moments where a new model suddenly clicked into our existing set of stories about how the world worked.

This process of *constructing*, not receiving, knowledge is the essence of the Piaget model of learning⁴ underlying experiential learning models^{19, 17}. Through external pressure, the learner is provoked to examine their cognitive models. This foreign element, as it is referred to in the Satir Change Model²⁰, causes the student to enter a period of chaos. During this period of disequilibrium, the student struggles to find a model that explains the world of apparent chaos. They may try to assimilate the situation into an existing model. They may replace their existing models with new ones. Alternatively, they may move back and forth between these two extremes and in the end *construct* new knowledge, new mental models, that work for them. For this reason, this model is sometimes called the *constructivist* theory of learning⁹.

A key for teaching effectively is to get the student to the point where they *want* to learn. Homework, quizzes, exams, projects, and deadlines are some standard mechanisms for engaging students. All of them serve to increase the level of inner conflict for students. They impose constraints that require the adoption of new models and skills in order for the student to complete the work successfully. We claim that by recognizing and using the role of conflict in learning, instructors can enhance student learning.

This is not to say that all conflict is conducive to learning. If the level of stress is too high, as in a battle, it may hinder or even stop learning⁷. If, however, the level of stress or disequilibrium is too low, there would be no reason to learn, since existing models may work well enough.

One problem with the conventional interpretation of conflict is that many students and instructors view conflict as negative *only*. As Fischer⁵ states, the traditional western culture views a breakdown as an “error to be avoided.” He argues that for us to be more effective, we need to migrate to a culture where people are actively engaged in design. Such designer cultures perceive a breakdown as an “opportunity for innovation and learning.” One of the goals of this course was for students to recognize this possibility.

To maximize the chance of using breakdowns as opportunities for design and learning, students should be able to freely discuss (among themselves and with the instructors) areas of conflict. This can be helped by (a) creating an environment where students feel safe enough to do this, (b) directing their attention to this issue, (c) welcoming discussions about conflict, and (d) providing them with tools to identify and resolve conflict.

Note that we are not saying that all learning is necessarily preceded by conflict, nor that conflict is the only key to learning. Once a student is ready for learning, they may proceed with little if any conflict. They may be more open to making subsequent changes too. A few people may never enter conflict, though we expect those to be very few indeed. Furthermore, effective learning requires many other elements, such as sources of new models to try, situations in which to practice, and communities for discussing results or designing solutions. Finally, we believe that the reflective practices that are valuable in any learning environment are especially valuable in situations with the potential for high inner conflict. Thus, conflict is only one of many aspects of learning.

In the next sections, we describe how we structured a software engineering course to facilitate learning in the face of the types of conflict typical of large team projects.

3. The Course

We applied these models in a 9-week course in software engineering at the junior undergraduate level, open only to computer science or computer engineering majors. There were 22 students* – two of them graduate students. Nine were women and thirteen were men. The teaching staff consisted of one lecturer (David) and one teaching assistant (Valentin). Our third co-author (Elizabeth) collaborated in the discussions to design and navigate the course. Instead of the standard weekly schedule of three 1-hour lectures and one 1-hour quiz section, we had three 2-hour class sessions. These sessions were either in a standard classroom setting with movable chairs (key for small team conversations) or in a computer lab. More details of the course structure are given in our paper on reflective techniques¹⁶.

Perhaps the four most important design decisions we made in the course were as follows.

1. We designed the course so that students could not succeed on their project unless they understood and applied the type of team and project coordination skills that are extremely important for doing team projects successfully. Most undergraduate computer science and computer engineering students have little appreciation or understanding of these soft skills,

* We started with 24 students, but two dropped out near the beginning of the course; both for family reasons.

perhaps because they have not needed them in order to succeed in their college classes. Hence, teaching students to value and practice these skills was one of the main goals for our course.

For this reason we assigned all 22 students to work in a single team on a single instance of a project. While this choice was viewed as risky by some of our colleagues and was unwelcome by some of the students, it forced students to deal with the project and team coordination issues. In the first week, after a brief discussion in class, the students decided to form sub-teams of 3-5 students. Each sub-team then chose one person to lead it. These leads together formed a Lead Team responsible for both making high-level decisions on the project and for coordinating the sub-teams.

In retrospect, this choice was a key element of the course design. While we did not explicitly introduce conflict in this case, we did consciously create a complex adaptive system⁶ from which the need for coordination would emerge. This led to the types of conflict about which we wanted the students to learn. In particular, students ran into a multitude of team and project issues that often do not arise or are easily ignored in smaller teams. These are among the types of situations that often frustrate engineers in industry. We elaborate on this discussion in later sections.

2. We designed the course around an experiential learning model¹⁹. This model has a learning cycle consisting of someone doing until they are blocked by a limitation; then reflecting, finding new models or skills to learn, applying these new models or skills, and doing again. The model was present in many aspects of the course. In the first class session, for instance, we had a discussion that uncovered this learning cycle from the students' own experiences; then we told them how this cycle was built into the entire structure of the course.

We scheduled project retrospectives every two weeks. Students had reflective writing assignments every week. They were in charge of running the entire project in order to fulfill the requirements of the external customer (a marketing person acting as a customer). We, the instructors, largely acted as facilitators and taught with our mouths shut⁴.

An unexpected result of this course design aspect was that students appeared to choose appropriate areas in which to push themselves. Instead of us, instructors, trying to determine the role in which every student would best learn, the students made these choices. Some wanted to try being leaders, so they volunteered for that role. A few weeks into the course one student became uncomfortable with the role of a sub-team lead. After discussing this with an instructor, the student returned to their sub-team and negotiated a role change. Another student focused on doing what seemed like cool technology and only at the end accepted that this choice had been at the expense of the entire project. One student who was an accomplished leader but wanted to focus on technology made an explicit and silent decision to let others lead.

3. We designed the course to devote considerable time and effort on reflective techniques, such as journaling, team conversations², retrospectives¹⁰, reflective essays¹⁸, and portfolios. (We describe these in detail in another paper¹⁶.) These techniques enhance learning in any

domain¹⁴. Forcing the time to practice them on a project that had periods of chaos and conflict helped students appreciate the value of reflection.

Two important decisions were (a) to set aside the first and last five minutes of each class period for everyone, including the instructors, to write in their journals, and (b) to have the journals remain private to each person. These gave students practice and allowed them to use journaling for all that was important in their lives, even matters that were quite personal or unrelated to the course. Both aspects helped them gain an appreciation for journaling as a reflective technique.

4. Finally, we devoted 8 of the 27 class sessions to guest sessions led by industry experts. The most successful ones were experiential simulations where students explored a question that related to their project experience via what at first may appear to be a trivial game. This provided examples of experiential learning in action. One session, also quite successful, evolved into an open question and answer period when the guest realized that the students were overwhelmed with their project and had many questions about “how it really is done in industry.” Other sessions involved two or more cycles of presenting material and posing questions, and then having students work on those in groups. The least successful session was primarily a lecture in style.

Another benefit of these sessions was that the discussions with these guests and the stories they told reinforced our message of the need for team, project, and reflective skills. As Sally Fincher points out, students listen to practitioners differently³ and appear more willing to believe them.

4. Classification of the Course Strategies

This section provides a more detailed discussion of individual techniques used in our course. A common model of reflection classifies it into three phases: reflection for-action (before action), reflection in-action (during action), and reflection on-action (after action)⁸. Similarly, the strategies we used to design and run this course with sufficient, yet not too much, conflict to enable learning may be categorized as strategies for-learning (prepare before), strategies in-learning (act during), or strategies on-learning (learn after) (Fig. 1). The for-learning strategies helped to create an environment with enough conflict for effective learning. The in-learning strategies helped to reduce the stress level during the course if it was about to become too high otherwise. The on-learning strategies helped to bring a sense of closure and broader understanding at the end of the course.

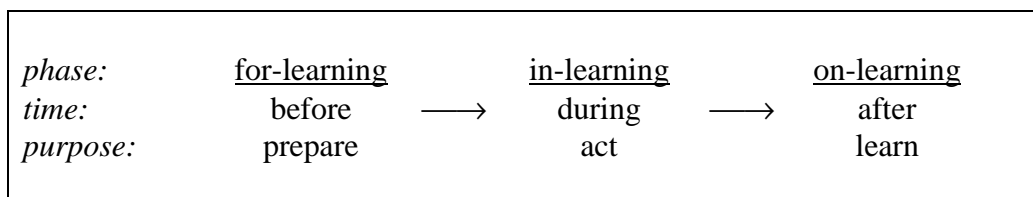


Figure 1: Sequence of strategies for designing a course around the use of conflict to promote learning

The in-learning strategies may also be categorized by a similar set of three phases: for-dealing-with-stress (before), in-dealing-with-stress (during), and on-dealing-with-stress (after) (Fig. 2). The for-dealing-with-stress strategies helped to avoid unnecessary stress before inner and inter-personal conflict arose. The in-dealing-with-stress strategies helped to reduce stress as conflict was building. The on-dealing-with-stress strategies helped to detect and reduce stress after the event(s) causing the conflict had happened.

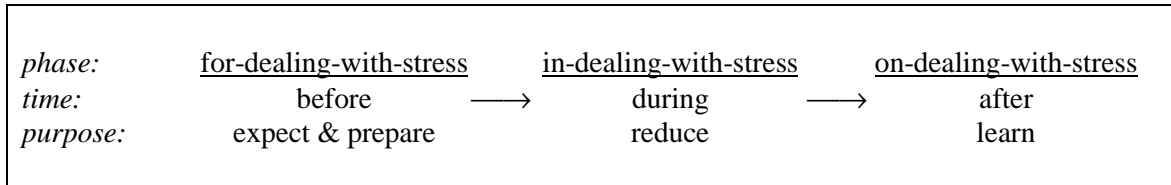


Figure 2: Sequence of strategies for dealing with stress resulting from the conflicts students experience during the *in-learning* phase of the course

The complete list of strategies we used and their position in these models as implemented in the class appears in the Appendix. In the next sections, we look at each of these strategies in more detail.

5. For-learning Strategies

In order to create an effective experiential learning situation that would provide enough challenge to the students, yet fit within an academic context, we designed the course around several for-learning strategies:

1. *Project based, a single large team.* To require students to deal with the team and project coordination issues that could be missed in smaller teams, the course was designed to be project-based where *all* 22 students worked in a *single* team for the duration of the quarter.
2. *Resembling real life.* To make the student learning relevant to their future careers, the project was done in an environment as close to industry as possible within the constraints of an academic 5-credit course. The main exceptions were that student learning was emphasized as more important than project success and there was no real customer[†]. The result was that students faced challenges similar to those we have seen in industry.
3. *Experiential learning; Teaching with our mouths shut; Large amount of student freedom.* To maximize student learning, instructors focused on being facilitators within an experiential learning environment. In the first class session, the instructors led a discussion with questions from *Teaching with Your Mouth Shut*⁴ whereby the students used their own experiences to derive the experiential learning model. There were only a couple of

[†] We would think carefully before having a *real* customer for such a course because this would increase the cost of failure, which in turn may prevent the students from taking risks and trying something new. Academia is *not* the real world, and it may be best to use that to our advantage by doing things that are not easily done in the real world, such as encouraging students to focus on learning *even if it may lead to project failure*.

traditional-style lectures. Instructors provided some project requirements[‡], possible choices at key turning points, observations, facilitation, and minor guidance. After an outside marketing person presented the customer requirements for the product, the students had the freedom and responsibility for running and managing the entire project.

In order to provide sufficient time for experiential workshops, we had three 2-hour class sessions per week (instead of the standard 1-hour session format). Both a classroom and a computer lab were reserved so that we could either do work around chairs, tables, and whiteboards, or work on computers.

4. *Experiential simulations.* To challenge students to reflect and to give them reflective guidance, we invited several outside experts from industry to facilitate 2-hour-long experiential simulations. Example topics included “What Do You Do When You Don’t Know What to Do?”¹³ and “Exploring Tradeoffs: Quality versus Speed”¹⁵.
5. *Emergent behavior & Complex adaptive system.* To allow students to regulate their own levels of stress and choose their own areas for learning we created a complex adaptive system, where conflict could emerge as a result of the actions students choose to take. Simple rules and rich relationships among the students allow complex behavior to emerge⁶. That complex behavior in turn increases the chances that conflict will also emerge. Highsmith states that a complex adaptive system is “an ensemble of independent agents, who exist at multiple levels of organization, who anticipate the future, and who form groups that occupy diverse niches.”⁶ Very similar to a team or company environment. The advantage of a complex adaptive system is that “innovation, creativity, and emergent results are born in the transition zone at the edge of chaos.”⁶

We created a complex adaptive system by specifying a few simple rules and then letting students act as they choose to. A set of containing rules bounded student and instructor behavior (e.g., 2-hour class sessions; respect others; instructors intervene if stress is too high). Aiming rules oriented students toward goals (e.g., grading criteria emphasized learning over project success). Diverging rules gave students freedom to choose (e.g., to decide how to lead and run the project and then do so). This allowed behavior, conflict, and learning to emerge.

6. *Emphasis on learning.* To promote learning, we emphasized that it was our paramount goal and set up the grading rules to reinforce this decision. We reminded students of this goal, of the model of learning from mistakes, and of other related strategies throughout the quarter.
7. *Expert practitioners.* To ground our assessments of the importance of soft skills in industry, we had eight class sessions where expert practitioners led experiential simulations or told reflective stories of their work. These guests often introduced other models of interpreting the world (e.g., the Satir Change Model²⁰), and that testing *is* science). One of the students

[‡] We restricted the set of tools so that (a) students would not spend too much time in that choice, and (b) we could provide them with an industrial level set of development tools.

also organized a tour of Microsoft where a panel of program managers and developers gave short presentations and answered questions from the students.

8. *Need-for over how-to.* To fit within the constraints of a 9-week course, we were more concerned with teaching need-for than how-to knowledge. The need-for is about appreciating that there is a need for some type of action, while the how-to is about how specifically to perform that action effectively.
9. *Challenge students.* To provide students with different perspectives of what was happening, we gave them assessments of the project status and of their individual work. This included questioning their design decisions in class (during the second half of the course), as well as providing feedback on their weekly reflective assessments. At times this caused conflict in the recipients, but the advice was always delivered with as much respect and integrity as possible. We, the instructors, taught by example, both openly giving and receiving such assessments between each other.
10. *Public presentations.* To force students to objectively evaluate their product and put those assessments in the perspective of what brings value to the customer, we required them to give two presentations to the entire class. One was a presentation by each sub-team on their part of the software architecture. The second was a final presentation to the surrogate customer on the day when students handed in the complete product: an installation disk accompanied by written technical and user documentation.
11. *Openness of reflective essays.* To promote student learning from the reflections of peer students, the weekly reflective essays were submitted to a publicly visible web site. One student mentioned reading some of these, but our perception is that most students were too busy elsewhere and did not take advantage of that opportunity. For the next version of this class, we plan to ask students if they did so on the end-of-course evaluation and questionnaire.
12. *Peer evaluations.* To promote learning from peer appraisals, on the last day of class we had each student anonymously evaluate each of the other students. The instructors then consolidated the feedback and sent each student their results, including any comments written about them by other students. Although this is valuable feedback, it could cause discomfort if a student's perception of their own value differs significantly from the perceptions of others. It also is not clear whether a single round of anonymous peer evaluations at the end of the course provides much value; if evaluations are used, a better strategy may be to do them before the end of the course in order to give students a chance to improve based on the feedback they have received.

6. In-learning Strategies

In order to keep the stress at a level appropriate for learning, we used a number of in-learning strategies. These strategies are classified into for-, in-, and on-dealing-with-stress.

6.1. For-dealing-with-stress Strategies

We used several for-dealing-with-stress strategies to prepare the students to avoid unnecessary stress due to the conflicts that might occur:

1. *Safety conversation.* Feeling safe reduces stress levels, so creating a safe team environment is important for avoiding unnecessary stress that may otherwise hinder learning. To put the students' attention on the need for safety in a team, and to help create a supportive team environment, the first conversation each sub-team had after forming was a safety exercise[§]. Sub-teams spent 30 minutes answering the following two questions – “What must happen in order for you to feel safe in your team?” and “What must *not* happen in order for you to feel safe in your team?” – before discussing these with the entire class.
2. *Team conversations.* To provide the students with the necessary tools to be members of an effective team, we gave them a list of ten conversations that lead to establishing and maintaining effective teams². Example conversations include committing to create a team that is safe for its members, and committing to choose a leader and to abide by that leader's decisions. The sub-teams had these two conversations in class. The rest we left for them to do, or not do, as they choose.
3. *Being on a path to mastery.* To make students aware of the need for persistent practice in order to learn and excel in any aspect of life, the first reflective essays in the course were on the book *Mastery*¹¹, a reflective book in itself. The students were asked to write about how this book related to the course topic (software engineering) and to themselves.
4. *Learning cycle; Teaching with Your Mouth Shut test.* To prepare students for accepting the conflict that is part of learning, we spent the first class session on a set of questions from *Teaching with Your Mouth Shut*⁴ to *construct* the learning cycle that is at the heart of experiential learning. This was also their introduction to our style of teaching with our mouths shut, for we provoked them to construct the learning cycle model themselves in response to questions from us. David remembers standing in front of the class after asking these questions, waiting for the students to speak up, and wondering how long it would take them to realize it was up to them to act.

6.2. In-dealing-with-stress Strategies

The class design included several in-dealing-with-stress strategies to reduce the stress that students create as they deal with their conflicts:

1. *Teaching by example.* In order to be congruent and to emphasize the importance of our claims, we taught by example as much as possible. During the journal writing periods^{**} David wrote in his expensive leather-bound journal, visibly demonstrating the value he

[§] See Norm Kerth's *Create Safety* exercise¹⁰ for another example of a safety exercise.

^{**} The first and last 5 minutes of each class session

attributed to his own journaling and perhaps making it easier for students to do something that might have looked silly. The instructors intentionally spoke when they thought the other instructor had said something wrong, or left out something important, and accepted the criticisms with grace, demonstrating that disagreeing was acceptable and showing techniques for doing so. When one student repeatedly acted in a manner that was unacceptable to teammates and others, David “fired” the student from the leadership role, demonstrating that certain behaviors are not tolerated and can lead to drastic action.

2. *Instructor as on-request facilitator.* In order to help students resolve their inner or inter-personal conflicts, the instructors offered to talk to students and facilitate between students as needed, and repeated this offer several times during the course. Sometimes students became emotional about some of the conflicts they had encountered, especially inter-personal conflicts, so the instructors had to take care to facilitate well.
3. *Instructor as observer + un-requested intervention.* In order to reduce the stress level in the class, we, instructors, sometimes intervened (but rarely unilaterally so) if we perceived the stress level to be too high for effective learning. This was a last resort strategy for us, since it removed the opportunity for students to learn how to deal with such situations themselves. More frequently, we would offer our observations (but not suggestions) as fodder for student learning and action.
4. *Openness of reflective essays.* In order to provide an opportunity for students to realize that others are having similar problems, the weekly reflective essays students wrote¹⁶ were placed on a web site visible to all. Of course, their stress level might have gone up if another student had posted a remark against them, but students did not post such remarks.
5. *Challenge students.* In order to provide students with different perspectives of what might be possible, we sometimes challenged their assessments of what was possible with respect to resolving conflict. For instance, on several occasions when students were angry with other students, we suggested that choosing the most favorable interpretation of why another student had done something might bring them closer to the true intentions of that other student.

6.3. On-dealing-with-stress Strategies

To notice and understand conflict after the events causing the conflict were largely over we used the following on-dealing-with-stress strategies:

1. *Reflective practices.* To maximize student learning, we embedded this project within a system of many individual and team reflective practices, such as journaling¹⁶. Reflective practices helped students notice, resolve, and learn from conflict.
2. *Instructor as observer.* To help notice patterns, it is useful to have an observer outside the team (outside the system) who provides feedback to the team. The instructors and guest facilitators helped fill this role by pointing out things that students may not have noticed or were likely to miss. One of the guest speakers, for instance, realized after observing one class session that the most valuable thing he could teach the students was the need to always ask, “What value am I providing to the customer?”

3. *Retrospectives.* To help the students try different ways of identifying and resolving team and project issues, we held retrospective exercises for 30 minutes on Fridays of every other week, and for a full 2-hour session in mid-quarter and again at the end of the quarter. Many of these retrospectives were taken from Kerth¹⁰. These exercises allowed students to both hear other students offering different interpretations of what happened, and get a sense of how much they have accomplished. Instructors participated as facilitators and by adding their own assessments and issues, as appropriate. Of course, retrospectives can also uncover issues that students (or instructors) had not been, or did not want to be, aware of. David remembers a retrospective session that pointed out a flaw in the initial course design; while he no longer recalls the specific flaw, he does remember the inner conflict this provoked in him.

7. On-learning Strategies

In order to create a sense of closure and new understanding at the end of what turned out to be an intensive course for some students, we used several on-learning strategies:

1. *Customer presentation.* In order to focus the students on the “whole product,” (not just the coding), they were required to give a customer presentation to our surrogate customer in the last week of the class. They presented the final product (CD-ROM, User Manual, and Technical Manual) and gave a PowerPoint-based presentation on the product’s features, demoed the product, and finally presented a list of features that could be added in future versions of the product along with their respective cost estimates.

Many of the students were at first surprised when we suggested that exaggerating a product’s capabilities might be a bad business strategy. They thought that they had to make the project appear more successful than it was.

2. *Personality types.* In order to help students understand the reasons for some of the interpersonal conflict they experienced in the course, we had them take an online Myers-Briggs personality test in the second-to-last session and then discussed the results in class. Understanding that other people *really do think differently* can make it much easier to respect them. What might have earlier looked like malicious intent on another student’s part might now be reinterpreted as good intent based upon a different story around the same events.
3. *Appreciation.* In order to part with a sense of accomplishment and appreciation for the other students, even if it was because the interaction with them caused challenge, we did the Appreciations exercise¹⁰ in the last session. This exercise takes the form of saying, “Joe, I appreciate you for ...” while looking at the person being addressed. Using exactly this form creates a powerful sense of being appreciated. Having to find something appreciative for each person helps focus people on the many good things that happened. First, we demonstrated this by saying an appropriate such phrase to each student in front of the class. Then we had members of each sub-team do the same among themselves.

8. Did Conflict Appear to Help Learning?

We used several mechanisms to assess how well students learned. We read their weekly reflective essays. We observed them in action on the project. We talked to them personally

when we found that they were struggling with a situation. We read their final exam essays where they wrote about what they would do the same or differently next time. We analyzed an anonymous take-home questionnaire, filled in before the last day of class, where students rated the value they got from each of 64 aspects of the course. Each item was rated “from –2 (negative value to you) to 0 (neutral value to you) to +2 (high value to you).” Finally, four months after the class ended we asked the students several questions about what they would change or keep in the course, what they valued in the course, how the times when other people were uncomfortable effected their own experience, and which of the reflective practices they have continued to use. We report elsewhere¹⁶ on the reflective practices that students found valuable and continued to use after the class.

When we designed the course, we did not anticipate writing these papers, and so did not organize the course in order to do research; our goal was to teach effectively. Thus, we only have anecdotal evidence about the causes for student learning or the impact of conflict in particular on their learning.

Comparing our course with previous instances of it is difficult because we taught it in a very different way. We used many “unusual” techniques, including reflective techniques, 2-hour class sessions, teaching with our mouths shut, devoting almost one third of all class sessions to guests, putting all 22 students on a single project, and using agile development techniques⁶. Students also may have been more predisposed to believe David because of his 11 years in industry.

Despite the lack of proof, we still believe that conflict helped learning in our course. There were ample situations in which students clearly were in conflict. This came out in their personal conversations with us and in their writings, which included examples of them reflecting on conflicting situations and coming up with plans for dealing with those better in the future. The next section includes some of these examples.

The relation between conflict and learning varied widely among the students. A few of them appeared to learn effectively without noticeable conflict. About a third had major conflicts from which they seemed to learn. Examples were failing as a leader, believing they were in the wrong sub-team, or being blind to the negative aspects of what they thought was cool technology. Most of the rest had what we perceive as minor conflicts that preceded learning. Unfortunately, there were a few who did not appear to extract value from their conflicts.

Even with the conflict some of them experienced, students appeared to enjoy the course: their end-of-course anonymous evaluation rated the course at 4.5 out of 5 (a very high grade for a course of this type). They asked for time to have a party on the last day of class and then organized it.

8.1. Examples of Conflict Helping Learning

This section lists some notable examples of situations in which we assessed that conflict helped learning in our course.

1. Working in a team of 22 created a lot of conflict for the students. They had never needed to coordinate much with others, and initially many believed they did not need to. As their

actions and reflective writings demonstrated, for many students this was a difficult lesson to learn. By week five, however, they were beginning to understand the need for more effective coordination. “I learned from the class last week [...] the importance of communication and coordination.” “I realized this week that I cannot single handedly make this project succeed.” “I can’t control everything even though I think I can.”

The results of having poor team coordination exploded in week six, when we, instructors, put the students’ attention on the chaotic state of the project. At that time, all students were focused on the coding. The Lead Team was not spending much time coordinating. Sub-teams were acting largely on their own and “fighting” with each other over who should change their side of the vaguely worded software interfaces. Some students were trying to control other students. It had become a sea of us versus them.

This was one of the rare times when we intervened, and we did so because the chaos level was too high. We sent an email to the students in which we gave our assessment of the dangerous state of the project, and listed 15 areas of concern. We scheduled that Friday’s session for each sub-team, including the Lead Team, to present the design of their component and to get feedback from the rest of the class. Each sub-team was to have 20 minutes, and all presentations were to include diagrams and the “key design decisions, assumptions, customers, business rules, etc.”

That Friday’s session was a turning point. It became clear to everyone that the team, and thus the entire project, was in chaos, as many of them noted in their weekly reflective writings. One student wrote: “What I learned this week could better be called a realization of what I’ve been learning about for the whole quarter. On Friday, each group presented its status, and it became clear that we were off-track [...] now I have a better understanding that all that ‘rhetoric’ we’ve been hearing throughout the class about communication, project management, etc., is real and dangerous to neglect.” Another student wrote that “the learning I had this week was tremendous: the importance of a team orientation, and not a group vs. group stance of what’s mine and what’s yours; that communication may not work even if both parties are trying hard to do so, but are doing so in different ways; that no matter where the project is going, its welfare [...] should not engender emotional attachment.” A third said, “Before last week, I didn’t realize how much preparation and effort the team leads needed in order to steer 20 other people to productively and effectively work on a project.”

What had been there but not spoken, was now out in the open. This enabled students to take charge and they did. After that class session, the Lead Team gathered to discuss what to do. The result was an email to the entire class acknowledging the problems and outlining a plan to “quickly pull together and recover from a project that has gone off track.” They created a spreadsheet to list the remaining tasks for each sub-team and to collect estimated and actual effort for each task. They scheduled a set of meetings that weekend for the sub-teams to fill in this spreadsheet. What resulted was a goal for having two use cases working by the following Monday morning. All with *no* involvement by the instructors. From that point on, the team pulled together. In the next two weeks they created a product with tested features, an installer, and documentation. As one student wrote, “Realizing that the project was getting off track was a major milestone. It was not until we came into terms with it that we started considering ways to control and reduce the level of confusion. We are currently

taking action and using the lessons learned during this chaotic period to better organize our work and ourselves.”

2. An extremely common theme in the students’ weekly writings was the importance of communication, dealing with teams and teammates, and managing teams. “Last week I learned that dealing with people is just as important a part of work as coding... In order to deal with people you need to be able to communicate effectively.” “Friday I was reminded (yet again) of the difficulties of trying to get a number of bright and motivated people to agree on a plan for attacking a complex and difficult matter. I learned first hand the need for a leader.” This was the dominant theme in the final exams too. The importance of team and project coordination appears to have been one of the big revelations for many of the students.
3. Another situation in which some students felt uncomfortable but appeared to learn from was when they were singled out to answer a question posed by one guest facilitator and did not have a good answer. The expert gave a short session on how important it is for software engineers to create value. He then asked several individuals what value they brought to the project. At least one student noted how uncomfortable they were when they were pointed at and “miserably failed to answer the question.” Many students reflected on this question, even though only a few were actually asked the question. Perhaps they had a moment of discomfort wondering if *they* would be called next and not have a good answer.
4. A common frustration among students was finding limits to their power as individual contributors. Several of them wrote about not being able to “control everything even though I think I can.”
5. Several students commented on how the practice of journaling helped them resolve conflicts. One student wrote of first realizing the value of journaling when in the process of writing about a problem a sibling was having the issues had become so clear that the student copied sections of that writing almost verbatim to send to the sibling. That student now professes to write about anything that is bothering them.

Overall, the students expressed much appreciation for this course despite the discomfort it had caused them. Example comments are:

- “Working on the class project was a lot more challenging than I had anticipated. It was not so much the programming part but more so the coordination and management aspect of the project. I have realized that without the proper management even the most qualified team of developers would be subjected to unavoidable failure. Therefore, in the future I will be more willing to follow a leader and I will have a less individualistic approach. In fact, I will make sure that I am working in a team with a clearly established leader and goals.”
- “I learned it is even more important to have a ‘good communication’ after miscommunication takes place.”
- “My experience in [the course] helped me when I worked in a group and probably made it easier to work in a team (because now I know that you most likely run into a problem).”

- “It’s been an intense and worthwhile experience, but it would have been nice if I hadn’t had to go through the pain of being yelled at.”

9. Conclusion

A purely negative view of conflict is fairly limiting, since it tends to cause us to look for solutions in the domain of zero-sum games – seeking ways to fortify our positions, to attack their defenses, and to win the fight. Perhaps this is due to the battle metaphor that is the first definition of conflict. The result usually is to become more rigid and focused on a limited space of winning over someone or something, rather than on finding a solution.

A more generative interpretation of conflict is “challenge.” Challenge tends to open our solution space to include win-win solutions. It also implies that the solution may involve changing *us*, rather than changing *them*. Given that we have very little power to change other people, starting with ourselves is much more realistic. It allows us to learn and innovate in situations that need precisely that.

Using this broader interpretation allows students to more readily accept the conflict inherent in the learning process and use it as a sign that a learning opportunity has arrived.

A course designed with appropriate strategies for creating, regulating, and learning from these types of conflict provides an opportunity for valuable learning, as demonstrated by the post-course feedback of our students.

Acknowledgments

We thank the many colleagues who helped us design and deliver this course: Jonathan Bach, Bjorn Freeman-Benson, James Bullock, George Engelbeck, Angela Linse, Dan Rawsthorne, Vibha Sazawal, David Schmaltz, Amy Schwab, Steve Smith, Stani Vlasseva, Skip Walter, and Sharon Whiting. We also thank the contributors to the SHAPE forum (<http://www.geraldweinberg.com/shape.html>) for helping us understand when conflict helps learning. We are grateful to the many students who gave us post-course feedback, and to the anonymous reviewers who provided helpful comments on the presentation of this material. This research was supported in part by NSF Grant numbers EIA-0090832 and EIA-0121326.

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Appendix. Classification of Conflict-Related Strategies

Table 1 below shows the complete list of conflict-related strategies we used and their position in the respective for-, in-, and on- models as described in this paper.

Note that some techniques can change places or appear in multiple categories. Several colleagues and students, for instance, recommended moving ‘Personality Types’ to the on-dealing-with-stress category so that the students would have this tool available during the course. The choice of where to place a strategy is likely to change how that strategy is implemented and the impact that it has on student learning.

Table 1: The conflict-related strategies used in our course, classified according to their role for learning and dealing with stress

Technique	Brief Description	Purpose
For-learning Strategies		
Project-based, a single large team	<ul style="list-style-type: none"> All 22 students worked together on a single project 	<ul style="list-style-type: none"> Force students to experience the need for team and project coordination
Resembling real life	<ul style="list-style-type: none"> We created a project that was as close to industry as possible within the constraints of academia 	<ul style="list-style-type: none"> Provide students with challenges similar to industry
Experiential simulations	<ul style="list-style-type: none"> Create challenging exercises with expert facilitators guiding resolution of the conflict that emerges 	<ul style="list-style-type: none"> Demonstrate how to use conflict to learn
Teaching with our mouths shut	<ul style="list-style-type: none"> We created an environment for experiential learning, used facilitation, and avoided lecturing 	<ul style="list-style-type: none"> Instructors will not make decisions for students Students expected to do things they do not know how to do Allow appropriate conflicts and lessons to emerge for each student
Emergent behavior & Complex adaptive system	<ul style="list-style-type: none"> A team of people working together is a complex adaptive system where behavior emerges due to the independent action of the people 	<ul style="list-style-type: none"> Conflict and learning opportunities emerge without the instructor’s intervention
Emphasize learning	<ul style="list-style-type: none"> We repeatedly stated that we were most interested in learning Reflections were a major part of the grade 	<ul style="list-style-type: none"> Foster culture of lifelong learning Make it acceptable to fail ... <i>if</i> this triggers learning
Expert practitioners	<ul style="list-style-type: none"> Expert practitioners from industry told stories of what worked and did not work for them 	<ul style="list-style-type: none"> May contradict students’ beliefs Helps students see that their problems are common
Need-for over how-to	<ul style="list-style-type: none"> We aimed to create an appreciation for certain skills, even if we could not teach those in their entirety 	<ul style="list-style-type: none"> May frustrate students trying to do what they do not know how to do
Challenging students	<ul style="list-style-type: none"> We provided honest assessments of students’ and project performance, including challenging their own assessments 	<ul style="list-style-type: none"> “Expert” feedback may contradict students’ beliefs Produce enough stress to create an opportunity for learning and force new models

Technique	Brief Description	Purpose
Public presentations	<ul style="list-style-type: none"> • Sub-teams presented their component architecture • Final official customer presentation 	<ul style="list-style-type: none"> • Force students to look at the big picture • Force enough stress for learning • Final presentation provides a sense of accomplishment
Openness of reflective essays	<ul style="list-style-type: none"> • Student essays stored digitally in a public domain site • Strictly confidential essays were accepted too by exception and not stored there 	<ul style="list-style-type: none"> • Promote sharing of ideas and experiences • Enable learning from peers • Promote understanding that others too face problems and that is okay
Peer evaluations	<ul style="list-style-type: none"> • Each student anonymously evaluated their peers 	<ul style="list-style-type: none"> • Could unsettle students if peer evaluations do not match their own self-assessment
In-learning Strategies		
For-dealing-with-stress Strategies		
Safety exercise	<ul style="list-style-type: none"> • What must happen for you to feel safe? • What must not happen for you to feel safe? 	<ul style="list-style-type: none"> • Put attention on the need for safety • Start the process of building safety
Team conversations	<ul style="list-style-type: none"> • 10 types of conversations that effective teams have regularly 	<ul style="list-style-type: none"> • Provide tools for running teams • Build trust in the team to allow for conflict resolution
Being on the path to mastery	<ul style="list-style-type: none"> • Students read the <i>Mastery</i> book and wrote about it 	<ul style="list-style-type: none"> • Proficiency takes years of practice • Be ready to learn from experiences and conflicts • Instill the culture of continual learning
Learning cycle	<ul style="list-style-type: none"> • Do; reflect; introduce new models; do again 	<ul style="list-style-type: none"> • Prepare to continually learn from experiences and conflicts • Do not expect clear-cut recipes!
<i>Teaching with Your Mouth Shut</i> test ^{††}	<ul style="list-style-type: none"> • What were your most significant learning experiences in life? • Was an instructor directly involved? 	<ul style="list-style-type: none"> • Get students to reflect • Learning is achieved by doing • Learn from “mistakes” • Instructor’s role is to facilitate
In-dealing-with-stress Strategies		
Teaching by example	<ul style="list-style-type: none"> • We showed respect for students and each other • We demonstrated that it was okay to disagree 	<ul style="list-style-type: none"> • Encourage students to model these behaviors
Instructor as on-request facilitator	<ul style="list-style-type: none"> • We invited students to talk about their problems, in private, with us as facilitators 	<ul style="list-style-type: none"> • Create an environment of safety • Demonstrate ways to resolve conflicts • Resolve conflicts
Instructor as observer	<ul style="list-style-type: none"> • We offered to facilitate students in addressing their inner or inter-personal conflicts 	<ul style="list-style-type: none"> • Provide help when students are stuck
Openness of reflective writings	<ul style="list-style-type: none"> • (see above) 	<ul style="list-style-type: none"> • Other students may have different views of the same situation
Challenging students	<ul style="list-style-type: none"> • (see above) 	<ul style="list-style-type: none"> • (see above)

^{††} A set of questions drawn from *Teaching with Your Mouth Shut*⁴

Technique	Brief Description	Purpose
On-dealing-with-stress Strategies		
Journaling	<ul style="list-style-type: none"> Writing in journals for the first and last five minutes of each class session 	<ul style="list-style-type: none"> Helps students notice conflict Helps students understand conflict Helps students construct ways to avoid the same conflict in the future
Reflective essays	<ul style="list-style-type: none"> Weekly 1-page reflective essays A take-home Final Exam 	<ul style="list-style-type: none"> (same as journaling) Can read other people's reflections
Instructor as observer	<ul style="list-style-type: none"> Instructors pointed out things that students may have missed 	<ul style="list-style-type: none"> Notice conflict or introduce alternative models Adjust level of conflict to benefit learning
Retrospectives	<ul style="list-style-type: none"> Group reflective exercises 	<ul style="list-style-type: none"> See different people's views of the same situation Place to acknowledge the good and the bad
On-learning Strategies		
Customer presentation	<ul style="list-style-type: none"> Presented final "product" to customer 	<ul style="list-style-type: none"> Be honest with the customer Gave sense of accomplishment, which reduced stress
Personality type test	<ul style="list-style-type: none"> All took the Myers-Briggs personality test and discussed its results 	<ul style="list-style-type: none"> Expect people to be different Promote respect for differences
Appreciations	<ul style="list-style-type: none"> We directed brief statements of appreciation to each student during the last session Students did the same among themselves in sub-teams 	<ul style="list-style-type: none"> Promote civility and starts the process of reconciliation and healing of wounds from past conflicts Reinforce the value of approaching people positively and teaches the value of treasuring them even over disagreements Remind that disagreements are rarely to be taken personally
Peer evaluations	<ul style="list-style-type: none"> We conducted a 20-minute anonymous peer evaluation on the last day of class Results were announced shortly after 	<ul style="list-style-type: none"> Students see themselves through the eyes of their colleagues and reflect upon disparities with their own perception of themselves