

A Qualitative Analysis of Reflective and Defensive Student Responses in a Software Engineering and Design Course

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ABSTRACT

For students encountering difficult material, reflective practice is considered to play an important role in their learning. However, students in this situation sometimes do not behave reflectively, but in less productive and more problematic ways. This paper investigates how educators can recognize and analyze students' confusion, and determine whether students are responding reflectively or defensively. Qualitative data for the investigation comes from an upper-level undergraduate software engineering and design course that students invariably find quite challenging. A phenomenological analysis of the data, based on Heidegger's dynamic of rupture, provides useful insight to students' experience. A clearer understanding of the concepts presented in this paper should enable faculty to bring a more sophisticated analysis to student feedback, and lead to a more informed and productive interpretation by both instructor and administration.

Keywords

student feedback, confusion, learning, phenomenology, dynamic of rupture, defensiveness, reflectiveness

1. INTRODUCTION

The ideas of threshold concepts [5, 16] and reflective practice [6] have begun to receive considerable attention in computing education research; the former to describe challenges facing students in the discipline, the latter to describe work required of students to meet those challenges. The term 'threshold concept' is defined as a concept which, once grasped, leads to a transformed way of understanding or a new phenomenological awareness. Transition to the new understanding (enhanced - or new - mental or conceptual models [3]) or the new awareness is typically preceded by some period of difficulty [16].

In the literature, reflective practice, critical thinking, and learning are often associated. Plack and Greenberg [20] provide an overview, referring to a number of researchers well-known in the field: Kolb [15] links reflection to learning and describes critical thinking as taking time to revisit and process experiences from a number of different perspectives before drawing conclusions. Brookfield [9] links reflection to critical thinking. Critical thinking uses the analytic process of reflection to extract deeper meaning from experiences. Atkins and Murphy performed a meta-analysis of the many definitions of reflection found in the literature and identified an essential three-element sequence common to all [1]: A **trigger event**, typically an awareness of some uncomfortable (positive or negative) feelings and/or thoughts; then, a critical analysis of the feelings and thoughts, as well as the experience which gave rise to them; last, developing new perspectives as a result of this analysis. Many researchers note that while reflective practice is

identified as important to learning, it has proven quite elusive to teach. Attempts to cultivate it often fall short [5,6].

1.1. Confusion, a part of Learning

Brown et al. [10] write of the confusion and uncertainty that attach to true learning, because it means encountering the unknown. Their comments indicate that the interval of difficulty which follows initial exposure to threshold concept material is filled with confusion, even when it is also filled with learning. Reflective practice is considered to play an important role in students' successfully navigating confusion. However, students in this situation sometimes do not behave reflectively, but in less productive and more problematic ways. Segal [22] has studied the relationship between reflective practice (or its lack) and the interval of confusion among adult learners. He asserts that, most of the time, exposure to challenging material (such as a threshold concept) initiates in the student an instance of Heidegger's dynamic of rupture, which culminates in reflectiveness or, alternatively, defensiveness.

Students' engagement in a non-reflective pattern has not received much attention in computing education research. Computing educators would benefit by a clearer understanding of the relationship between reflectiveness and its less desirable alternative, and the origins and indicators of each. This paper uses findings from the literature (particularly Segal's work) and experience with a course to investigate how educators can recognize and analyze students' confusion, and determine whether students are responding reflectively or defensively.

1.2. A more Sophisticated Approach to Qualitative Student Feedback: not just good and bad

Beyond student learning, the research has implications for understanding students' feedback, particularly their anonymous evaluations of the course and instructor. Applying Segal's analysis to this data not only enables better understanding and response to areas of students' difficulty. It also supports a more informed interpretation than simply 'yes' or 'no' votes on the course and instructor. A clearer understanding of the concepts presented in this paper should enable faculty to bring a more sophisticated analysis to student feedback, and lead to a more informed and productive interpretation by both instructor and administration.

Section 2 supplies motivation and background for the paper: how reflective practice matters to learning, the difficulty in cultivating it, and a preliminary look (the layperson's view) at reflectiveness and defensiveness. Section 3 holds a deeper exploration of reflectiveness and defensiveness, and their role in the dynamic of rupture. Section 4 describes CSX, a software

engineering and design course for upper-level undergraduates that students invariably find quite challenging, and from which qualitative data on student experience is drawn. Section 5 provides a representative sample of student feedback data, an explanation of the interpretation schemes used to analyze it, and preliminary analysis. Section 6, the conclusion, summarizes the relevance of Heidegger's dynamic of rupture - and Segal's analysis of it - for interpreting students' course evaluations, and looks to future work.

2. MOTIVATION AND BACKGROUND

Anonymous student evaluations in CSX consistently exhibit a bifurcated distribution: either strongly positive of the form "Good course, I learned a lot", or strongly negative of the form "Bad teaching, disorganized course". The combination suggests that something more complicated, not simply poor teaching, is happening. To investigate that possibility and elicit more meaning from students' anonymous evaluations and other qualitative feedback, this paper lays the foundation for applying a Heideggerian analysis (Segal's explanation of the dynamic of rupture) to the data.

2.1. Learning and Reflective Practice: an overview

Booth discusses the distinction between two broad categories in approaches to learning: surface and deep [5 p.145]. Surface approaches are associated with symbols or words. They direct attention on the sign, the representation itself. Students who use this kind of approach are more focused on the task per se, without consideration of its origins, consequences, or context. It can be summarized as "learning the text", and may take the form of literally memorializing course material.

In contrast, deep approaches focus on meaning, on that which is represented; it can be summarized as "learning through the text". Booth notes that deep approaches to learning are associated with quality learning outcomes, characterized by seeing the world in new ways [5 p.138,p.146], and understanding content from a multiplicity of critically different perspectives, a point also made by Berglund [4 p.19]. The capacity to shift among different perspectives to suit the task at hand has particular importance in computer science, where different understandings have relevance to each of many tasks, including designing software, writing code, or determining requirements with a user. Deep approaches depend on bringing students' behavior into their awareness and subjecting it to reflection so that *[their] meaning schemes may be transformed by reflection on anomalies* [16 p.13]. Counter-intuitive or threshold concepts (which form much of CSX content) are not learned in straightforward linear fashion, but rather require reflection [16 p.10].

Extending a metaphor from Plack and Greenberg [20 p.3], the kind of learning to which CSX is directed (as an advanced undergraduate course) comprises two main aspects, and can be likened to the double helix of DNA. One strand holds the cognitive content particular to computing and software development; it is acquired by cognitive effort, including memorization. One strand is composed of context, meaning, and their interplay; it is acquired through reflection, a practice common to all fields of learning, and related to the "deep learning" mentioned above. In her research, Booth draws on phenomenographic studies in multiple fields, because, as she notes, they all report similar findings with respect to learning, independent of content area [5 p.138]. Schon's book addresses

multiple professions [21]. Similarly, for this paper I draw on literature from a number of professions, all directed toward the second strand of learning: that related to reflective practice.

2.2. Cultivating Reflective Practice

Three points frequently found in the literature with regard to cultivating reflective practice have particular relevance for this paper: First, the capacity for reflectiveness is founded in making explicit those factors which are typically left implicit, or making visible those assumptions which are typically taken for granted and unspoken [5, 22]. Second, some precipitating condition (Atkins et al.'s trigger event) gives rise to - and is required for - reflectiveness [20]. Third, significant difficulties attach to teaching and cultivating reflective practice [7]. Authentic reflective practice involves becoming aware of one's habitual behavior. Citing Nietzsche, Segal notes that if self-observation is done by rote, it leads to confusion rather than insight. *'Never to observe in order to observe. That gives a false perspective, leads to squinting and something false and exaggerated. ... One must not eye oneself while having an experience; else the eye becomes an evil eye.'* ... [A] dogmatic commitment to observation produces a disengaged and decontextualised relationship to one's practice. [22 p.75] citing and commenting on [18]. Authentic reflective practice is not done formulaically [20 p.1549]. Reflectiveness must come from a student's internal process, and questioning arises out of her dynamic engagement with the content. Booth also notes that questioning done by rote, or imposed by the teacher in a formulaic manner, leads to disastrous results [5 p.145].

2.3. Reflective vs. Defensive Responses: a preliminary look

From the layperson's perspective, reflectiveness and defensiveness are understood as radically different from each other. Defensiveness is associated with an incident-specific increase in emotion that overshadows other aspects of an encounter and effectively prevents further discussion of the topic at hand; in shorthand, an ad hoc reaction of: "NO, DON'T". Reflectiveness is associated with diminishment of emotional investment, a kind of long-term stepping back to see better; in shorthand, an attitude of: "Hmmm, I wonder..." Studies abound about the difficulty of engendering reflective practice [7]. These shorthand descriptions leave many questions unanswered, including: What makes reflectiveness so difficult to engender? What motivates it? How does defensiveness occur? Where does it originate? How can it be ameliorated? Both reflectiveness and defensiveness raise some difficult questions. The next section explores them more deeply, and lays the foundation to more precisely formulate and investigate the research question for this paper.

3. REFLECTIVENESS AND DEFENSIVENESS, COMPONENTS IN HEIDEGGER'S DYNAMIC OF RUPTURE

According to Segal, in an article meant to support teaching and learning in adult education, reflectiveness and defensiveness represent alternate paths through Heidegger's *dynamic of rupture* [22] citing [13]. The action of the dynamic is founded in Segal's observations of adult learners, informed by his knowledge of Heidegger. It takes the form of a three-step sequence: rupture, explicitness, response (either reflective or defensive). In this section, I draw on the literature to analyze the dynamic, and examine each of its steps in turn, as well as

several underlying concepts on which they're based. Then the origins of reflectiveness and defensiveness can be expanded and refined, clarifying the distinctions and similarities between them in order to better address the research question specified in section 3.4.

3.1. The Dynamic of Rupture - Explicitness - Response: overview and underlying concepts

This dynamic can be explained by an example from Dreyfus [12], familiar to anyone who's traveling internationally for the first time, perhaps to attend a conference: Each of us "knows" what particular distance to stand apart from an acquaintance when engaged in conversation. In general, we have no awareness of the specific distance, nor that it changes in proportion to the degree of our intimacy with the other person, nor that we have been socialized to it, nor even that we are doing it. This "know-how" resides in the **realm of the unseen taken-for-granted**. However, when we encounter conference host country natives who use a different conversational distance, we experience them as standing uncomfortably close (or uncomfortably far away), and **we suddenly become aware of our accustomed distance**. The discomfort thus becomes associated also with the emergence into visibility of our own behavior. According to Segal - and it is borne out by the student data from CSX - this discomfort is experienced either reflectively or defensively. Segal's explanation of distinct forms of differentness clarifies the two possibilities.

3.2. Distinct Forms of Differentness

Segal [22 p.76] citing Bauman [2 p.143] distinguishes between two kinds of differentness or otherness: the oppositional (in shorthand: 'enemy') and the unknown (in shorthand: 'stranger'). The oppositional is defined according to the same rules as we, but oppositely. Continuing the example of interpersonal conversational distance, the international traveler may respond: "The (host country) natives are standing the wrong distance away. How unrefined and uncivilized. What a collection of unrefined clods and uncivilized barbarians." Their differentness is thus defined in opposition: their 'wrong' vs. one's own 'correct' distance, their 'unrefined' vs. one's own 'refined' nature, their 'uncivilized' vs. one's own 'civilized' actions. **Defining the other in opposition, as 'enemy', confirms one's view of the world:** One's concept of the correct distance, and who decides it, remains untouched. Questioning of one's own or the other's behavior is not required; in fact, it has no place.

Enemies share common boundaries; although they oppose each other, they have a common appreciation of the rules in terms of which they meet each other ... [Enemies] function in the space of the existentially familiar... [22 p.76] quoting [2 p.145].

Alternatively, the unknown is defined according to unknown rules, or perhaps not defined at all. The international traveler may respond, "What is happening here?", and eventually, "What does this mean? Does it mean that I have an accustomed distance? If so, how did I learn it, what length is it measured at, and how do I figure it out? Does it mean that they have an accustomed distance? If so, how do I learn it, what length is it measured at, and how do I figure it out? Is my lack of local know-how making them uncomfortable? How long will it take to learn, what will I do in the meantime? ..." Segal calls this *enter[ing] a state of inarticulateness* [22 p.78]. **Recognizing the other as unknown, as 'stranger' evinces the inadequacy of our worldview.** This unmediated encounter with the unknown poses a considerable challenge. Questions - but no

real answers - abound. Bauman refers to it as the *'anxiety of strangeness'*:

Strangers have no established boundaries in common - not even terms of which they meet each other... [Strangers] give rise to the existentially unfamiliar ... [T]here are no ways of reading [such] a situation that can be taken for granted. ... The anxiety of strangeness is experienced not only in the face of the stranger but in the face of strange and unfamiliar situations - in any situation in which we cannot assume our familiar ways of doing things. [22 p.76] quoting [2 p.145].

Enemies and friends, or enemies and oneself, represent two sides of the same coin. Strangers - or strange, unknown situations - represent a different coin altogether.

3.3. Beyond Rupture and Explicitness: reflectiveness and defensiveness

Segal notes that both cognitive and emotional elements are involved in the consequences of rupture and explicitness, because high emotional arousal, either anxiety or excitement, forms an integral part of being attentive. Segal uses the term **reflectiveness** to mean the process of examining (and thereby possibly changing) currently held beliefs. He uses the term **defensiveness** to mean a refusal to examine, and a rigid holding to - even idealizing, currently held beliefs. Note that this requires something having been made explicit, in order to hold to it. **Both reflectiveness and defensiveness (or dogmatism) are freighted with uncertainty and anxiety, and either can follow equally from explicitness.**

Defensiveness serves a protective purpose: It shields the responder from having to experience the shock of estrangement (and concomitant unease and uncertainty) from the everyday taken-for-granted context in which he encounters the world. **A defensive response to explicitness is characterized by recasting the unknown (strange) explicit as the known oppositional (enemy) explicit.** It enables the responder to remain in the realm of the known and the unquestioned, without being forced to examine it. **It is enacted through the mechanism of projection, displacing onto others the uncertainty and anxiety engendered, and blaming them for one's predicament;** for example the international traveler's first response.

Boud also speaks to the challenges of reflectiveness and the emotional elements involved, citing earlier researchers and characteristics of reflection such as *perplexity, hesitation, doubt [11], inner discomforts [8], or disorienting dilemmas [17]. ... reflection involves a focus on uncertainty, possibly without a known destination* [6 p.15].

In summary, **rupture is required for explicitness; explicitness serves as a pre-condition to both reflectiveness and defensiveness.** Both reflectiveness and defensiveness arise from encounters with the unknown, and include significant affective components. A defensive response means avoiding the challenges of uncertainty and its affective components; a reflective response means taking on those challenges.

A point of terminology: Segal consistently uses the terms **rupture** and **explicitness** to signify a sequence of two stages in Heidegger's dynamic, where explicitness means a sudden, unbidden dawning of awareness. He introduces the terms **reflectiveness** and **defensiveness** as forms of explicitness, but throughout the paper, he uses them to convey a different shade of meaning: a kind of living with - in tension, not

accommodation - an extant explicitness. Occasionally, he writes about them as distinct from explicitness: *explicitness can equally lead to defensiveness [or reflectiveness]* [segal p 88]. I have taken that distinction as fixed, and use the term **response** to signify a subsequent (third) stage in Heidegger's dynamic, a stage consisting of either reflectiveness or defensiveness.

3.4. The Research Question

The most educationally productive question becomes clear: How to engender a reflective response in every student under all conditions, or failing that, how to transform defensiveness into reflectiveness. Addressing it requires understanding sufficiently the nature and origins of defensiveness and reflectiveness, to recognize and distinguish between them. This paper lays the groundwork by addressing a preliminary question: **What in student feedback data evinces instance(s) of the dynamic of rupture, and how are reflective and defensive responses distinguished one from another?** To investigate this question, I bring the literature to bear on data from course CSX, which is introduced in the next section.

4. THE CSX COURSE

CSX, a software engineering and design course, is offered to upper-level undergraduates. The partial course description in this section sets a context for analyzing qualitative student feedback, the focus of this paper (a fuller description of the course is left to another paper). To the extent that space constraints allow, this section contains elements of the course relevant to student experience: content, structure, pedagogy, and format.

4.1. Course Overview and Structure

CSX is meant to teach software development fundamentals in a way that transcends software tools and languages, yet engages students in the actual practice of software, not just a theoretical or anecdotal exposition. In keeping with the principle of technology-independence, pencil and paper could suffice - although students may prefer to use a word processor and printer - for every assignment except the last. In keeping with the principle of engaging students in the actual practice of software, the group project - and the course - concludes with an assignment to write a correctly running program consistent with the documentation that was used as a design medium for it and the encompassing program family.

CSX is organized in three segments: two iterations linked by an intervening bridge. During the first iteration, students work on a series of individual 'design and development' assignments, motivated by two purposes: Each assignment is intended to make explicit some point(s) that play a significant role in software quality, but which are often left implicit in programming courses for a computer science degree; for example, subtle ambiguities in specification. Each assignment is also intended to identify and clarify some distinction(s) that play a significant role in software quality, but which are often not addressed directly in those same courses; for example, functionality vs. implementation. The second iteration is devoted to a group project with multiple assignments that reprise the content of iteration I, in a more challenging problem; for it, students also draw on each other as resources. Two or three assignments related to design for ease of change provide a bridge between the two iterations. The bridge covers possibilities for criteria used in modular decomposition, the

design of module interfaces, and the implementation of designated modules in ways that support maximum flexibility.

4.2. Course Format and Pedagogy

Success in CSX requires mastery of several counter-intuitive concepts. To support students' authentic reflectiveness, course pedagogy is guided by the principle that they learn most when engaged with the material through their own questions. As Booth recommends, new concepts are introduced through homework assignments rather than lectures, and these assignments are given without classroom examples that students can simply adapt and use as a template [5 p.149]. Consequently, students come to the next class meeting *with a background of half-formulated queries and difficulties [when] ... their own worlds ... encompassed the field of the new concepts, and they had questions of their own at hand, grounded in their own enquiry* [5 p.149]. A similar approach was taken by engineering mathematics faculty at Chalmers University of Technology in Sweden [5] citing [14]. Homework assignments are not regarded as having exactly one correct answer, determined by the teacher, and students' submissions are not treated as mistakes, especially during the first iteration. The degree of students' efforts on an individual assignment is judged both by what they submit and by their participation in class discussion (in small classes, these discussions demand more than simply reciting text). Grading policy has changed over time. More recently, a student's first iteration scores are not counted in figuring the final grade, provided that she makes a serious effort on each individual assignment.

Elements of CSX classroom dynamic resemble the conversational classroom described by Waite et al. [24]. The first half of a class meeting is devoted to discussing assignments just submitted or being returned. Students' submissions are introduced (anonymously) as a foundation for collective exploration and analysis. Students may, and frequently do, identify their own ideas, or introduce new ones. Their (mis)conceptions often come to light while discussing a proposed solution and its implications. The implications can themselves be further examined, in keeping with Booth's dictum about a requirement for real learning: To become aware of their own learning, and variants in the ways a phenomenon may be experienced, students must subject their own work, and others', to scrutiny and reflectiveness [5 p.137]. The power of the course to effect student learning derives partly from using their own work (their 'mistakes') as subject matter; this holds their attention and begins with what has meaning to them, two pedagogically important considerations.

4.3. CSX Content

Course content draws from the work of David Parnas, where design has primacy of place. Rather than a series of software projects to be coded with little attention to how that is done, the course is constructed as a sequence of assignments meant to illustrate points of practice, and to give students *sufficient instruction in how to put the pieces [of software development] together* [23]. In order for students to concentrate on a particular aspect of development, rather than be distracted by the complexity of a problem's content, the content domain is chosen as the smallest problem that can bring that aspect of software development into focus. For some homework assignments, the content may appear simple, even trivial; but treatment of that content - what is intended for the students to learn - becomes both sophisticated and accessible. This section

project, and end-of-term interviews with each student were instituted for evaluating student performance. The logs were kept for accountability purposes: each student recorded all communication with other group members, including dates and times, participants, and tasks accomplished; they contained very little qualitative data. End-of-term interviews were conducted to determine an individual student's contribution to the group project and her knowledge of the course material involved; initially, only occasional notes were taken and preserved.

For the last three semesters, end-of-term interviews were recorded (by hand) for later analysis. They provide a means to better understand students' learning experience in CSX, and to refine teaching accordingly. In the most recent offering, during class discussions on the group project, students often spoke about material that they were clearly wrestling with, or thinking deeply about. In order to obtain an account in their own words, I invited them to record these thoughts in their logs; the students began to call them journals. Sources are noted for each piece of data included in the next section.

5.2. End-of-term Recorded Data and its Interpretation

No student explicitly states that she experienced the dynamic of rupture, much less engaged in a reflective or defensive response. Therefore, conditions must be specified that establish a classification scheme for the student feedback data. (Note that from the vantage point of the research question in section 3.4, the ideal specifying conditions - which may or may not exist - would cleanly partition the data into two sets: one definitively expressing reflectiveness, one definitively expressing defensiveness.) The actual classification conditions were devised by reasoning from the data, in the context of findings from the literature.

5.2.1. End-of-term Feedback: indications of reflectiveness

As noted in section 1, reflective practice is required for deep learning, which is characterized by new ways of knowing [5]. Therefore, data which explicitly evinces real learning, a change in thinking, or a change in practice can be classified as definitively denoting reflectiveness. Examples of this include:

end-of-term interviews from spring, 2005: Question 5. Looking back over the course, does it appear different to you at the end of the semester than at the beginning or middle? If so, how?

(student_S7): I never knew another way of learning software development but to take that blind route. In this project, I'd thought the main focus was code. When we sat in the lab coding, and it wasn't working, I thought: there must be something to that module design document (I just happened to look at it while sitting in the lab). It said 'this invokes that' and we weren't doing it that way, and we were more focused on getting the code done. And I thought why did [instructor] give us [these three weeks of other assignments] before code, if it's all about code? Maybe it's not all about the code. ... With the [design in documentation already done], you just have to worry about the final step of coding it in [any] language. ...

end-of-term interviews from spring, 2005: Question 6. What will you take away with you from the course?

(student_S4): Analyzing problems, analyzing software, and ways to go about developing software. I used to code software offhand without going off and thinking about it [first]. This

course really helped me to go off and think about it. I'm not afraid anymore to program, I know that. The real duty behind software development isn't code. Code equals a small percentage. Really: it's sitting down and really thinking it out.

Q: What do you mean, 'afraid to program'? Did you used to be?

A little bit

Q: Can you expand on that?

Like the [kwic index] program: if you think about how to proceed, it would get overwhelming, almost like, 'Where do you start?'

Q: And now you have an idea of where to start?

Yes, now: I don't think about program in terms of lines of code, how many functions. Problems don't seem as big as they used to, they're simplified. [Now,] I'd take a project, break it down to its core elements, and really focus on that...

Q: When you 'go off and think about it', what does 'think about it' mean?

What is the underlying problem, what underlying job needs to get done? Break down the problem into pieces, each piece has its own duty or task, functionality. Instead of a big, round ball, [it becomes] things more like blocks.

excerpted from spring, 2003, anonymous student evaluations:

(student_A9): This course is a great course. It is very intellectually demanding and academically challenging. I was thinking of suggesting this course be required for computer science, but I would not. I think this course is only appropriate for those who are seriously interested in software engineering. Should there be a 2nd course based on this course? Absolutely.

5.2.2. End-of-term Feedback: indications of defensiveness

According to Segal, defensiveness is evinced by casting the source of explicitness (i.e., the teacher or the course) as a source of problems. Examples of this include excerpts from spring, 2003, anonymous student evaluations:

(student_A1): I think this class was much more difficult than it had to be. ... My main concern was trying to interpret what was being asked, instead of learning the material. -- A separate point - we spent 2 periods going over the [kwic index program] - Why? Why the line by line analysis of the KWIC index program? This has little value - except to confuse and bewilder the class.

(student_A10): Could not ask questions and get a straight answer, answers were always left ambiguous. ... Gave no examples of personal experiences, homework assignments were changed during class and not a full understanding was given, never told us what she really wanted or expected, lecture was often not helpful in understanding material, I wouldn't take this course again, I wouldn't take this course if it wasn't required ...

(student_A12): ... It took me 3/4 of the course to understand the "purpose" of the course and the approach. Most of the time the instructor appeared to be unprepared and unorganized. I had the feeling of "drifting" and not going anyplace. ...

5.3. In-process Recorded Data and its Interpretation

Almost all the data collected at semester's end, a kind of after-the-fact reportage, fits into one of the two classifications. However, for most of the group project, data recorded in the midst of students' actual process (as entered several times per

week in their logs) does not satisfy either defining condition given in section 5.2. It does consistently display a heightened level of affect, even anxiety, even among students whose projects later turned out well.

5.3.1. *In-process Feedback: indications of anxiety*

Excerpted from fall, 2005, group project logs

(student_S1, week 1 of 5, after group meeting): ... It seems to me that we were not getting anywhere very quickly and this undertaking was larger than I previously had thought. What seems like such a straightforward assignment has become very complex ...

(student_S2, week 1 of 5, after group meeting): ... I'm a very calm and balanced person, and never really get stressed out about anything homework-wise because of the timeline I usually follow when I work. This project is already starting to stress me out because of the seeming lack of progress that we've gotten through so far. It seemed to me to be a fairly straightforward assignment at first, especially given the examples of the circles and the KWIC index, and I had hoped to hammer out a good outline to the [documents] within the first two sessions. We're nowhere near that yet. ... It feels like we're getting nothing done, and right now I don't necessarily know where to work next on my own. ...

These excerpted log entries confirm the relevance of Segal's analysis; students are experiencing the effects of explicitness. That is, they are experiencing a period of confusion after being exposed to threshold concept material, but before developing the corresponding mental or conceptual models or acquiring a new phenomenological awareness. The distinctions described in section 5.2 between reflective and defensive responses do not fit this data. More work is required to identify and develop the skills for analyzing stand-alone in-process data. For now, it may be analyzed retrospectively, in the context of end-of-term feedback. A retrospective interpretation scheme can be explained through the example of the international traveler.

5.3.2. *Retrospective Interpretation: footprints*

In our example of the international traveler, a threshold concept regarding the existence and length of accustomed conversational standing distance might be phrased as: "I have been socialized to use a set of conversational standing distances particular to my culture. People in other cultures are socialized to the set of distances particular to their respective cultures. In any encounter with others, I can include within the field of my attention an awareness of our standing distance, adjusting it if necessary, for as long as it takes for us each to feel at ease."

If, as a result of responding reflectively, the traveler can come to this concept, she will eventually manage encounters with host country natives relatively free of uncertainty and discomfort; and she will be equipped with this new awareness for all her subsequent travels. If, however, the traveler responds defensively, the heightened affect has little chance to subside except by the traveler's returning home without having integrated any learning. In subsequent journeys this traveler will likely continue to encounter the world at his original level of phenomenological awareness, and may well experience a repeat of the dynamic of rupture on the same terms as before. Note this means that **the nature of the traveler's response (reflective or defensive) can be discerned after the trip by whether or not her view of the world has changed.**

One can apply this same reasoning to interpret in-process CSX student data: Due to students' more highly charged state during response (of either type) to the dynamic of rupture, data collected in the midst of such experience may not offer clean delineations between reflectiveness and defensiveness. More information can be gleaned by comparing this data with semester's end reportage. If in-process data indicates a student's heightened affect with regard to elements of CSX content or goals, one looks to that student's semester-end data, and **examines the footprints.** If his view of those elements has changed in any significant way, one can conclude - retrospectively - that he was engaged in reflectiveness. And if not, then not.

6. CONCLUSIONS AND FUTURE WORK

Segal's explanation for Heidegger's dynamic of rupture offers a tool to analyze students' experience of learning challenging material, and the confusion it elicits. It is explained in section 3 through the example of an international traveler. Subsection 6.1 holds a summary explanation. Implications for interpreting students' qualitative feedback are found in 6.2. Subsection 6.3 enumerates some directions for future work.

6.1. Reflective and Defensive Responses

To summarize Segal's explanation: explicitness (the unavoidable - and unchosen - coming into awareness of some phenomenon previously outside of awareness) plays a significant role in real learning. Explicitness does not arise from a linear progression of events, but only as a result of rupture or disturbance, an unexpected encounter with the existentially unfamiliar, either persons or situations, that induce the anxiety of strangeness. In turn, it gives rise to either reflectiveness or defensiveness; these arise from encounters with the unknown, and include significant affective components. In contrast to a lay person's casual understanding (section 2.3), a defensive response means avoiding the challenges of uncertainty and its affective components; a reflective response means taking on those challenges. **Reflectiveness does not equal contemplation.**

6.2. Anonymous Student Evaluations: beyond good and bad

This paper illustrates the relevance of Heidegger's dynamic of rupture (as formulated by Segal) for analyzing students' learning and experience of CSX, and its role in enabling a more sophisticated and productive interpretation of their course evaluations. That combination makes a strong argument for the potential value of the dynamic to other instructors in other computing courses, particularly as an interpretive tool leading to more effective use of their students' feedback. For example:

If student evaluations for a course exhibit a bifurcated distribution (one portion quite positive, the other quite negative), it may well result from thoughtful teaching of difficult material, particularly if some students speak about the value of the course for their learning. The students' feedback may be taken to indicate their experiencing the effects of explicitness (in Segal's terms), corresponding to a period of confusion as part of their learning challenging concepts; some are responding reflectively and some defensively. If the instructor is attempting to present the difficult material of computer science and the students are encountering the challenges it poses, the department's support of that instructor

and her capacity to foster reflectiveness will benefit both students and the profession.

6.3. Future Work

This paper lays the foundation for future work in a variety of directions: course changes resulting from analysis with the dynamic; clarifying exactly what in CSX triggers the dynamic of rupture; refining analysis of students' in-process feedback data; and cultivation of reflective rather than defensive responses.

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