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Scaffolding the appropriation of self-regulatory activity: A socio-cultural analysis of changes in teacher–student discourse about a graduate research portfolio

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Abstract. This study informs the design and development of pedagogical agents that can flexibly support self-regulation by calibrating guidance to specific phases and facets of self-regulated learning (SRL) as individuals encounter challenges and develop more sophisticated understandings of the task and content. From a socio-cultural perspective of self-regulation, we examine the transition of self-regulatory control from teacher to graduate student during naturalistic instructional conferences. Three goals included (a) examining teacher–student dialogue about a complex task to see if fading actually occurs, (b) examining whether support and fading of support are calibrated to specific phases of the self-regulatory process at a given point in time, and (c) examining techniques used for scaffolding and fading scaffolding directed toward specific phases and facets (behavioral, cognitive, metacognitive and motivational) of the self-regulatory cycle. Findings support a socio-cultural perspective of SRL demonstrating a transition from teacher to student regulation across phases and facets of SRL. The paper concludes with an examination of how our findings can inform the design of computer-based scaffolds that can support SRL.

Consistent with the goals of this special issue, this paper examines the evolution of scaffolding dialogue in face-to-face discussions. Our focus was specifically on the evolution of naturalistic teacher–student dialogue as it occurred in face-to-face instructional conferences early and late in an academic year. We wanted to understand how human agents strategically scaffold self-regulated learning (SRL). Specifically, we explore how learners and instructors monitor, regulate and appropriate control of student self-regulation of task understanding, goal setting/planning, strategy enactment, and reflective adaptation. Students in our study were charged with the task of developing a graduate level research portfolio that evidenced growth and competency in research methods. Rather than comparing the portfolios themselves, or the

effects of different scaffolding conditions, we examined change in the ownership of self-regulatory activity evidenced in teacher–student dialogue from early (October) to late (March) in the task completion process.

Unlike most papers in this special issue, computers were completely absent from the instructional and scaffolding exchanges. Instead, our goal has been to systematically capture the ebb and flow of naturalistic scaffolding dialogue as learners and instructors reflect forward and backward in an emerging task space. We posit that this type of naturalistic examination of scaffolding provides the necessary information for designing pedagogical agents with the potential to adaptively and fluidly support students at the appropriate phases of self-regulation and with the appropriate level of support.

Scaffolding by its very nature involves "a form of assistance that enables the child or novice to solve a problem, carry out a task, or achieve a goal that would be beyond his or her unassisted efforts" (Wood et al. 1976, p. 90). Wood et al. emphasized that learners can be assisted by having more capable others (parents, teachers, or peers) control some aspects of the task while learners develop sufficient understanding and mastery. Central to the notion of scaffolding is the gradual appropriation of full control of the thinking, managing, and enacting the task at a pace that is appropriate for the individual learner. That is, support is carefully calibrated for the learner and the task. Support ebbs and flows as the learner appropriates control and encounters new challenges (Stone, 1998). Wood et al. identified ways that tutors scaffold perceptual, cognitive, and affective components in the learning process including simplifying the task, focusing attention on specific features of the task, demonstrating solutions, controlling and redirecting emotional responses, helping students focus on productive learning goals, and activating interest in the task.

Discussions about the misuse of the term "scaffolding" to refer to tools or structures that are constructed and deconstructed to support student learning have been ensuing for the last few years (c.f., Stone, 1998). However, many contemporary technologies and instructional design contexts for scaffolding learning consistently over-emphasize the application of tools and under-emphasize scaffolding as interaction involving diagnosis, calibration, and fading (Puntambeker & Hübscher, 2005). Scaffolding ebbs and flows, changing shape and form as the learner grows and develops mastery of content and processes. As a result, scaffolding is individualized and evolutionary. Although embedded agents have been used to foster metacognition, planning, strategy use, and motivation, we know of no work wherein

agents engage in the three fundamental scaffolding processes of diagnosis, calibration, and fading.

Purpose of this study

This study was conducted as a precursor to the design and development of tools in the Learning Kit project (Winne et al., 2004). The goal of this project is to develop cognitive tools to guide and support both individual and collaborative regulation of learning. More specifically, our intent was to inform the design and development of pedagogical agents that can flexibly support self-regulation by calibrating guidance to specific phases and facets of self-regulated learning as individuals encounter challenges and develop more sophisticated understandings of the task and content.

Central to our analyses were three elements described by Puntambeker and Hübscher (2005): diagnosis, calibration, and fading. Three goals for this study included (a) examining teacher–student dialogue about a complex task to see if fading actually occurs, (b) examining whether support and fading of support are calibrated to specific phases of the self-regulatory process at a given point in time, and (c) examining techniques used for scaffolding and fading scaffolding directed toward specific phases and facets (behavioral, cognitive, metacognitive and motivational) of the self-regulatory cycle.

We posit that this type of investigation of naturalistic teacher–student scaffolding dialogue has the potential to guide the design of computer-based pedagogical agents that have capacity to help students develop understandings and refine strategies for understanding tasks, setting goals and making plans, strategically engaging in a task, and metacognitively evaluating and updating understandings of their own self-regulatory processes. Much like an extensive body of research that examines the adaptation of teaching to individual differences (c.f., Corno & Snow, 1986), we aimed to examine the adaptation of teaching to individual differences in SRL. This study primarily answers the question: *What does research tells us about guiding and scaffolding metacognition and SRL*? Specifically, we examine how teachers help students to self-regulate their learning and then support students in appropriating control of their self-regulatory process over time and across phases of SRL. This study is important because it demonstrates that live tutors calibrate self-regulatory scaffolding to specific phases of SRL and transition that support across phases as students take ownership of their own self-regulation. We conclude with a discussion about the last two questions that are

central to this special issue: (1) How do our research findings guide the development of metacognitive tools to foster SRL, and (2) What are the challenges we face in designing adaptive scaffolds that can intelligently scaffold self-regulation by assisting in diagnosing specific problems and calibrating support to the appropriate phase of self-regulation.

Self-regulation in learning

Self-regulated learners are strategic learners who purposefully fine-tune their learning approaches and beliefs to particular learning tasks and contexts. Ideally, these learners persist when faced with challenge and playfully experiment with their learning. SRL is a multifaceted process. Many models of SRL have been primarily concerned with how individuals monitor, evaluate, and regulate their own behavior, motivation, and cognition (Zimmerman, 1990). Models of SRL emphasize goal-directed behavior wherein goals provide standards for monitoring (Pintrich, 1995; Schunk & Zimmerman, 1997; Zimmerman, 1990). Theory predicts that more sophisticated self-regulated learners are better able to regulate and control these facets of SRL than their less masterful counterparts (Lindner & Harris, 1998; Zimmerman, 1990). Research has yet to adequately explain (a) how learners regulate and control these facets at different points in the learning episode, and (b) how scaffolding for self-regulation may be calibrated to specific facets and phases over time and across different types of tasks.

There are many models of SRL, each with a different focus (c.f., Zimmerman & Schunk, 2001). Despite the fact that four key facets (cognition, motivation, behavior, and metacognition) are central in most models of SRL (c.f., Zimmerman & Schunk, 2001 for a comparison of models), there is some inconsistency in the ways facets (motivation, cognition, behavior, and metacognition) and phases (task definition, goal setting/planning, enacting, and evaluation/adaptation) of SRL are conceptually integrated.

In this study, Winne and Hadwin's (1998) 4-phase model of SRL will be used to guide our investigation. This model emphasizes monitoring, regulating, and evaluating across four phases: (a) task definition, (b) goal setting and planning, (c) execution of the task and enactment of strategies for completing the task, and (d) global evaluations and metacognitive adaptations about cognition, behavior, and motivation across prior phases. In this model, metacognition is central to the self-regulatory cycle. Students metacognitively monitor

their progress against standards and adjust metacognitive thoughts and strategies accordingly. They do this within and across phases of self-regulation. According to this model, students cycle through four self-regulatory processes over time, focusing on task definition, goal setting and planning in early stages of task engagement, and then emphasizing strategy engagement and higher level evaluation and adaptation as the task unfolds while still revisiting and refining task definition and goal setting and planning as they go. Whether and how teachers attune supports to specific phases of the self-regulatory cycle has not been explored in the literature.

Recently, Hadwin (2000) has re-framed the Winne and Hadwin (1998) model as a socio-cultural model of self-regulation emphasizing the complex interplay between the learner and the social context that supports and frames that task. Hadwin argues that as soon as students are faced with a new task they engage in a socio-cultural dance fitting the task into the context and letting the context tell the story of the task. This study teases apart the facets of SRL (cognition, behaviour, motivation, metacognition) from phases of SRL (task definition, goal setting/planning, enacting, and evaluation/adaptation) introduced by Winne and Hadwin and elaborated by Hadwin to explore ways in which metacognitive understandings of tasks and task contexts were supported through teacher–student dialogue. Therefore, the focus of this study is a sociocultural analysis of the development of SRL as evidenced through teacher–student discourse about a complex academic task.

Social aspects of self-regulated learning

The role of social context in self-regulation has evolved since the 1980s when researchers such as Corno, Collins, and Caper (1982, as cited in Corno & Mandinach, 2004), Zimmerman (1989), and others began to describe and research SRL as a sophisticated process related to academic achievement. The notion that social context or environment is an important part of student's SRL is evidenced in Zimmerman's (1989) socio-cognitive model of self-regulation. Zimmerman, building upon Bandura's (1986) socio-cognitive theory of learning, proposed that SRL involves personal, behavioral, and environmental processes. Therefore, the successful completion of tasks involves personal perceptions and efficacy, as well as environmental conditions such as support from teachers and feedback on previous problems.

Despite the centrality of social context in models of SRL, we agree with Corno and Mandinach (2004) that times have changed in the last

20 years to reveal (a) increased interest explaining precisely the role of social and contextual influences on SRL, and (b) emerging models that move social context from a component in the triadic processes of SRL to the socio-cultural center of SRL. Some contemporary views of SRL acknowledge external influences and the role of context as inputs to a self-regulatory system (e.g., Meyer & Turner, 2002; Perry et al. 2002). Nevertheless, the social or contextual aspects of self-regulation are vastly different as theories move along a continuum from more individual constructivist to more social constructionist perspectives (Hadwin, 2000; Meyer & Turner, 2002).

Socio-cognitive perspectives of SRL

From a socio-cognitive perspective, learners are active in interpreting and reorganizing ideas, and the instructor's role is to orchestrate learning. Learners are believed to be influenced by and act upon the social context. Consistent with this view, socio-cognitive models of SRL have viewed the individual as an active agent who strives to take control of learning. Schunk and Zimmerman (1997) described self-regulatory development as influenced by social and self. They suggested that learners at different stages of self-regulatory competence draw on different social influences beginning with observational learning (modeling, verbal description, social guidance and feedback), then self-imitation, and gradually progressing to self-regulation. Modeling is the process by which observers pattern their thoughts, strategies, and behaviors to reflect those displayed by one or more models (Schunk, 1998).

From a socio-cognitive perspective, SRL is situation specific. Students may be very productive self-regulators in one context and not as efficient in others (Schunk, 2001). From Schunk's perspective, students learn to engage self-regulatory activities by first observing modeled behavior, then practicing that behavior in contexts where instrumental feedback is available. Both Schunk (2001) and Zimmerman's (2000) socio-cognitive models of SRL emphasize modeling and prompting as key instructional tools for promoting SRL. Based on a socio-cognitive perspective, we would hypothesize that teacher–student dialogue early in a new task should be dominated with modeling, providing verbal description or instruction, social guidance, and feedback. As students develop competence with the task content and context, the development of self-regulatory control should be evidenced by a shift from social influences to self-influences wherein students rely on internal standards, self-reinforcement, self-regulatory processes, and self-efficacy beliefs.

Socio-cultural perspectives of SRL

Socio-cultural perspectives view self-regulating as a stage occurring as children are socialized into speech patterns and practices (Gallimore & Tharpe, 1990). According to Gallimore and Tharpe, self-regulation exists first in the practices of adults as they model activities. Over time, as they begin to understand how self-regulating activities relate to one another, students begin to imitate or take on parts of the activity. From this perspective, students are seen to be self-regulating when self-regulatory activity appears in their own performance. Ultimately, these behaviors become internalized and automatized. Therefore, self-regulating, according to Gallimore and Tharpe, is an early stage in the progression toward automatization of speech.

Similarly, Diaz et al. (1990) suggest that self-regulation can be seen as a social process because it appears first in the social world (on an intrapsychological plane) and then becomes appropriated into a child's way of understanding, appearing on the interpsychological plane. Gallimore and Tharpe (1990), and Diaz et al. primarily theorize about self-regulation of speech in young children; however, this view has informed the way we approach the study of SRL in adult populations. Diaz et al. rely heavily on Vygotsky's notion of internalization to describe the transfer of self-regulatory functioning and control from the social plane to the individual psychological plane. Rather than emphasizing modeling, they emphasize the notion that appropriation of SRL occurs in the context of joint problem solving. Teachers must first create intersubjectivity where the student redefines the problem situation in terms of the instructor or "other" perspective. Once students share the teacher's goals and task definition, they can begin to appropriate self-regulatory control.

From this perspective, scaffolding is a primary mechanism for relinquishing control of SRL to students as they develop competence and mastery in a given context. Scaffolding refers to the gradual withdrawal of teacher's control and support as a function of student's increasing mastery of a given task. A second mechanism involves creating intersubjectivity by providing rationales and explanations of plans, goals, and activities.

Building on similar socio-cultural foundations, McCaslin and Hickey (2001) emphasize the role of emergent interaction where teachers and students transition from co-regulating learning toward self-regulation of one's own learning. They suggest that students begin tasks as other— and setting-involved depending upon the social instructional environment and move toward task— and self-involved, or

intrapersonally directed. They found that when students and teachers co-regulate student's self-evaluation, students begin to develop realistic self-evaluations. Most significantly, McCaslin and Hickey acknowledge that school tasks are embedded in layers of social context and activity and that students must come to know and define goals and also coordinate and prioritize multiple goals.

Self-regulatory ownership

Based on these socio-cultural perspectives of self-regulation, this paper examines the transition of self-regulatory ownership or control from teacher to student during naturalistic instructional meetings. We hypothesize that teacher-student dialogue early in a new task should be dominated with teacher direction in the form of instruction, elaboration, and rationale for various phases of SRL. Early in task engagement, students might be expected to primarily observe as the teacher demonstrates and describes aspects of task engagement. Throughout the paper, we refer to this process as *teacher-direct regulation* of learning because the teacher is either doing or demonstrating how to self-regulate. As students are enculturated in the task and task context, teacher regulation should give way to shared responsibility for regulating learning (co-regulation). *Co-regulation* refers to instances when teacher guide or prompt students to do the regulating themselves, or students request, or prompt teachers to show them how to self-regulate. In both cases, students begin to take ownership of self-regulatory actions and thought but rely on the teacher to help out. And finally, as the student appropriates control, self-regulatory activity should reside with the student as he or she actively controls and reflects on self-regulatory processes and products. We refer to this final phase as *student-direct regulation* of learning, more commonly referred to as SRL.

Regardless of the social perspective chosen, there seems to be consensus that students should learn to adopt or take control of their own self-regulatory strategies and processes. There should be a shift from teachers doing the regulating by providing direct instruction and modeling toward the student taking control and demonstrating self-regulatory competence. In this paper, we test this hypothesis and examine whether scaffolding diagnosis, support, and fading are attuned to specific phases of the self-regulatory process, not just individual differences in the domain knowledge. In conclusion, we suggest this investigation has implications for the design of computer based prompts and guides for self-regulated learning.

Method

Description of research context

This study was conducted in a six-credit, year-long graduate course on research methods and analysis. The course provided an introduction to philosophies and methodologies of inquiry, research design, and data analysis to approximately 40 graduate students. A major year-long task assigned to students in this class was to develop a research portfolio that demonstrated growth and competence in three main areas: (a) research methodology and design, (b) quantitative analysis, and (c) qualitative analysis. A detailed description of the portfolio assignment follows. The course was team-taught by three instructors and two teaching assistants. The first author was a primary instructor; the second author was a teaching assistant. Course-work included class discussions, small-group work, research apprenticeships, writing assignments, final exams and the development of a research portfolio. Students met individually with an instructor to review the portfolio at least three times in the academic year. In this study, we focused on the first and the last portfolio meeting to best capture changes from early to late in the academic year.

Participants

Ten participants (all female) from a graduate research course were randomly selected from 30 consenting participants. Participants represented a range of skill and performance levels: grades ranged from 79 to 96 on the portfolio assignment (class $M = 80.56$, $SD = 6.79$), 72–89 in the course (class $M = 79.32$, $SD = 6.62$), and 46–89 on the final exam (class $M = 72.48$, $SD = 11.81$). The grades of the randomly selected 10 participants varied from 79 to 96% on the portfolio assignment (class $M = 80.56$, $SD = 6.79$), 72–89% in the course (class $M = 79.32$, $SD = 6.62$), and 46–89% on the final exam (class $M = 72.48$, $SD = 11.81$). Although some might argue that graduate students have achieved self-regulatory competence, Winne and Hadwin (1998) argue that SRL is something that continues to develop over a lifetime. As graduate students are faced with new and challenging content and processes, their self-regulatory activity and support become central to task and content mastery. Further, Hadwin et al. (2003) research with graduate students in research methods, demonstrates a great deal of variability in their self-regulatory sophistication.

Finally, graduate level learners have been largely ignored in empirical studies of self-regulation.

Portfolio assignment

The goal of the portfolio assignment was to give students an opportunity to demonstrate growth and competencies they developed in research design and analysis. Following Perry's (1998) recommendations for the design of tasks that promote SRL, the portfolio was designed to provide choice over challenge and tasks. Students were encouraged to set their own goals with four constraints. First, the portfolio should include about 30 entries representing their competency in three areas: research design, quantitative data analysis, and qualitative data analysis. Second, entries in the portfolio should include four pieces of information including (a) clearly defined learning goals, (b) documentation of progress towards the goal, (c) self-reflection about what the student had learned, and (d) self-evaluation of progress towards the goal (portfolio criteria). Third, students were required to attend four individual portfolio conferences with an instructor or teaching assistant. And fourth, students were required to complete four progress reports (following conferences) reflecting on the strengths, weaknesses, and future direction for the portfolio. The portfolio was described on multiple occasions in class. Students were provided with a written assignment description and a reference chapter about the purpose and types of portfolio assessment (Spandel, 1997). Class time was also allocated to view sample student portfolios from previous years.

Audiotapes of portfolio conferences

Conferences were conducted mid-October (Time 1), November, January, and March (Time 2). Each session was audio taped. For this analysis, the first and final conferences were selected to contrast changes in SRL. Further, both the first and last portfolio conference loosely followed the same structure: students were asked to explain the purpose of the portfolio assignment, and describe each of the required criteria. The rest of the conference involved students reviewing their portfolios based on assignment criteria. Conferences were unstructured instructional sessions guided by student's questions and completed portfolio entries. These sessions were intended to be geared to individual needs. Conferences lasted from 20 to 60 minutes and

transcript length ranged between 3000 and 8000 words. These conferences were the main data source for this study.

Portfolio progress report

After each portfolio conference, students were encouraged to listen to the portfolio conference tape and asked to fill out the portfolio progress report. The first report listed the task criteria and required students to (a) describe the criteria, (b) identify specific strengths and weaknesses in their portfolio entries, and (c) describe something they could do to improve the portfolio for the next conference. After Time 1, it became clear that students were struggling to identify task criteria, so we provided details about the task criteria on the portfolio progress report. For example, an instructor would say something like "These are the characteristics of a clearly defined goal: (a) clearly identified and easy to locate, (b) represents the main things learned about research methods and analysis, (c) relates to the content and readings in the course, and (d) demonstrates engagement with course material."

Qualitative discourse analysis

Studying how individuals appropriate self-regulatory talk and actions requires that data be collected and examined over time. Examining SRL as a series of events extending over time is the only way to understand how self-regulatory competence develops and changes (Hadwin et al. 2004; Perry, 2002; Winne et al. 2001; Winne & Perry, 2000). This paper examines teacher–student dialogue at the beginning of an academic semester, four weeks after a complex task had been assigned (Time 1), and at the end of a semester, 4 weeks before that same assignment was submitted for a final grade (Time 2).

Analysis of the portfolio conference transcripts was conducted in four stages, loosely following the method described by Karasavvidis et al. (2000). Each stage of analysis was dependent on the prior stage of analysis. The same validation procedures were used across all stages. That is, a test case (Time 1 only) was coded by the first coder and then reviewed with the second coder before proceeding to assign the remaining codes. The same researcher coded all remaining data for Time 1 and all of data for Time 2. Two other researchers then reviewed every segment and every code. Disagreements were resolved through discussion between all three research-

ers and relevant codes were subsequently re-examined across all cases to ensure total agreement on every code for every case. Miles and Huberman (1994) argue that this process of ''check-coding,'' namely the refining of code definitions with other researchers, is ''a good reliability check'' (p. 64).

Stage 1

A segmentation and coding scheme for identifying meaningful segments of teacher–student dialogue was developed. We started with a process called segmentation by idea used by Merrill et al. (1995) whereby all transcripts were divided into smaller units. According to this process, the idea or purpose of an utterance, rather than punctuation or length, guided segmentation. Each segment would then have either a student code or a teacher code assigned depending on the purpose and the speaker. The codes used were modified versions of those used by Karasavvidis et al. (2003). Descriptions and examples of these codes can be found in Appendix A. If a single teacher utterance served two instructional purposes, it was divided into two segments and assigned two teacher codes. On the other hand, lengthy monologues containing several utterances but serving only one purpose had only one code applied. No segment was double coded. Vague or confirmatory comments were not considered.

Stage 2

Following Karasavvidis et al. (2000; 2003), we used four main categories of self-regulatory ''ownership'' (see Table 1): (a) teacher-direct-regulation (instances when the teacher initiates and does the self-regulatory work), (b) teacher-indirect-regulation (when the teacher prompts to engage the student to do the self-regulatory work), (c) student-indirect-regulation (when the student requests assistance or information from the teacher to help self-regulate learning), and (d) student-direct regulation (when the student initiates and completes the self-regulatory act alone). When segments contained multiple scaffolds or more than one speaker, appropriation of SRL was assigned based on the main emphasis of the segment. For example, segments where the teacher asked a question (teacher-indirect) but then spent the segment answering the question were coded as teacher-direct rather than teacher-indirect.

Table 1. Coding for self-regulatory ownership

Ownership code	Description of code	Example from data
Teacher-direct regulation	–segment is dominated by teacher direction –teacher says or demonstrates what it is or how to do it or how to think about –teacher initiates action, reflection, evaluation, etc.	Teacher: What I want to do next is I want to show you this portfolio progress report. Now this is the first progress report because this is our first meeting and we're going be going through four of these and the way this looks like right now might change over the course of this work right now. Considering what you've brought in with your portfolio we want to look at how you define the criteria for each of these four things that we talked about right now and as when you go away from our meeting you're going look at strengths. Using examples from your portfolio to date, from your own portfolio strengths and examples weaknesses and action for the future.
Teacher-indirect regulation	–segment involves the teacher trying to get the student to regulate behaviour, motivation, cognition, etc. The segment includes the student's responses –teacher tries to get the student to say or demonstrates what it is or how to do it or how to think about. –teacher initiates but the emphasis is on getting the student to act, reflect, monitor, evaluate, etc	Teacher: Of the four kind of main criteria that she's going look for which one are you most comfortable with and which one are you least comfortable with? Like if you were to look at all your entries across the board which one did you think which one of these criteria did you think you did the best job at. Student: Um I think I did maybe the best in the evaluation. More towards I guess the second time around.

Table 1. Continued

Ownership code	Description of code	Example from data
Student-indirect regulation	–student tries to get the teacher to say or demonstrates what it is or how to do it or how to think about. –student asks for help, guidance, feedback, information, etc. –student may provide leads for the teacher to fill in or to act, reflect, monitor, or evaluate	Student: It's not like, I would need something to wrap it up. Teacher: Right, right. You want to say how close you were to achieving the goal that you had set out. Student: So basically even I could even say that these things in short here are the main qualities that I expect to find in an instrument.
Student-direct regulation	–student initiates action or reflection –launches into a discussion or review of what they have done or what they know	Student: I mean I, I've learned one thing I've learned is that I think the way I learn or my instinct is to be very methodical? And so that steps in quantitative are far less murky than in qualitative and it's just like this but that's not what I want to do for my study. Because for my study I want to I don't want to just do stats and numbers but instinctively I'm not designing it, I'm not creative about it, I just follow the rules because I think it's it makes more sense to me. That I sort of said I didn't say it very well I don't know, maybe I did. Do you understand what I'm saying? Teacher: Yeah.

Table 2. Coding for SRL facets and phases

	Description of code	Example from data
Facet of SLR		
Cognition	–Segment focuses on awareness and emergent development of factual and procedural knowledge (e.g., perception, comprehension, managing prior knowledge)	*Teacher*: So when you think about documenting examples of your progress, what what do you think she's [going] look for, when when she's looking through your portfolio, when she wants to see that you've documented and given her examples of how what you've learned and how you've progressed in the course.
Behavior	–Segment focuses on tactics and strategies; (e.g., time planning, effort planning, persisting, help-seeking, self-observation)	*Student*: What I've done is I've tried to just go through it, and I'm just like writing everything down in my own words to help me like...and I don't think I will do that with every single
Motivation	–Segment focuses on awareness and management of motivational processes (e.g., interest, efficacy, attributions, goal-orientation, value)	Student: nobody wants to admit that, we all do this just for our own benefit.
Evaluating/Reflecting	–Segment involves reviewing and making judgments about task engagement, task complexity, task difficulty and task criteria	*Student*: Like the pink highlights are the information that I considered important when I was reading the article and the blue highlight identifies that the study has a correlation
Phase of SRL		
Task definition	–Segment involves defining the elements of the task: parameters, context, time constraints, available resources, necessary subject matter expertise, etc.	*Teacher*: So there's another criteria for learning goals. Learning goals refer to something new that that you learn about the content of the course or applying the content of the course that you didn't know before.

Table 2. Continued

	Description of code	Example from data
Goal setting and planning	–Segment involves discussing how the learner is planning and coordinating activities related to the task. Focus is on what to do and how to do it.	*Student*: my my paper I can add...my paper from my reading course] right here *Teacher*: Well not the you don't even need to put the whole paper but you [might put the] the section that demonstrates this is something Student: just the section that I didn't understand that I now do
Executing	–Segment involves engaging in or actually carrying out process, tactics and strategies to address the task.	*Student*: So here, I'm just going to give you this to sign (student hands progress report to Teacher)
Evaluating/Reflecting	–Segment involves reviewing and making judgments about task engagement, task complexity, task diffi-culty and task criteria	*Student*: Like the pink highlights are the information that I considered important when I was reading the article and the blue highlight identifies that the study has a correlation

Stage 3

We considered both the function of speech (e.g., requesting information) and how those utterances relate to the task (i.e., content of utterances) by identifying which self-regulatory facet was being emphasized in each discourse segment (see Table 2). The categories were as follows: (a) focus on thinking (cognition) including what or how to think about the task; (b) focus on doing (behavior) including what has to be done to complete the task; (c) focus on feeling (motivation) including effort and interest related to the task; and (d) focus on monitoring or evaluating product or process (metacognition).

Stage 4

In order to study the evolution of self-regulatory control, we looked across all four recursive phases of self-regulation (task definition, goal setting and planning, strategy enactment, and evaluation and adaptation). The purpose of Stage 4 was to assign each segment a code related to which phase of SRL was being emphasized (see Table 2). Recognizing that segments coded as phase 3 enacting often included elements of phase 4 evaluation and adaptation (students were reflecting on what they had done), we decided to include only Winne and Hadwin's (1998) first three phases of SRL. Three phases of SRL coded as follows: (a) task definition (defining the task parameters, context, purpose or features); (b) goal setting/planning or segments (discussing or constructing plans or goals for engaging in the task); and (c) enacting (executing or reviewing strategies for completing the task).

Findings

To account for the fact that raw frequencies for teacher–student dyads are not comparable across dyads, we converted raw frequencies to percentage of total coded dialogue. These relative frequencies convert all raw frequencies to a common metric that can be compared across students. A limitation of this approach is that measures of self-regulator ownership (teacher-directed, co-regulated, and student-directed) are not independent. Because our hypotheses focused on specific comparison of ownership at time 1 versus time 4, and not factorial main effects or interactions, we conducted targeted *t*-test comparisons with a conservative Bonferroni adjustment.

We hypothesized a decrease in teacher-directed dialogue, and an increase in student-directed dialogue over time. Raw frequency counts of number of words spoken were translated to percentage of total words spoken by both the teacher and student in each conference. This measure of relative frequency is sensitive to variations in the length of conferences. Table 3 presents the mean percentage of total words spoken by the teacher and the student at Time 1 and Time 2. As hypothesized, we found a shift in domination of the dialogue with teachers withdrawing and students increasing their roles in the discussion over time. Paired samples *t*-tests indicated a statistically detectable decrease in the number of words spoken by the teacher from Time 1 to 2 ($t = 6.58$, $p < 0.025$, $d = 2.0$)[1], and increase in the percentage of total words spoken by the student ($t = -6.58$, $p < 0.025$, $d = 2.0$).

We hypothesized an increase in student-direct regulation and a decrease in teacher-direct regulation over time reflecting student appropriation of SRL. We also hypothesized that co-regulation would mediate that transition staying consistent over time. Co-regulation comprised all instances of either teacher-indirect or student-indirect regulation. Findings partially supported our hypothesis (see Tables 4 and 5). There was a statistically detectable decrease in the percentage of total dialogue coded as *teacher-direct regulation* ($t = 2.96$, $p < 0.003$, $d = 1.18$), and a statistically detectable increase in student-direct dialogue from Time 1 to Time 2 ($t = -5.38$, $p < 0.003$, $d = 1.41$). There was no statistical difference in the incidence of co-regulatory activities over time. However, co-regulatory activities played a fairly minor role

Table 3. Percentage of total and total coded words spoken by the teacher and student

		Teacher		Student	
		M	SD	*M*	SD
Time 1	Percentage of total	71.28	9.54	28.72	9.54
	Total coded words	3563.70	1172.26	1389.20	513.44
Time 2		53.36	8.35	46.64	8.35
	Total coded words	1841.60	585.26	1576.30	491.12
Paired *t*-test	6.58*	$p < 0.025$	−6.58*	$p < 0.025$	

*$\alpha = 0.05$, Bonferroni adjustment for 2 tests, $p = 0.05/2 = 0.025$.

Table 4. Mean percentage of total dialogue: Appropriation of SRL across phases of SRL

	Task definition		Goal setting planning		Enacting strategies		Total	
	M	SD	*M*	SD	*M*	SD	*M*	SD
Teacher-Direct								
Time 1	23.26	5.64	11.07	4.37	6.13	3.20	40.06	8.17
Time 2	7.29	5.74	9.59	3.33	10.17	6.19	26.79	11.28
Co-regulation								
Time 1	20.511	7.10	3.22	7.11	6.20	5.07	29.93	5.22
Time 2	6.92	3.67	6.59	3.67	16.75	5.65	30.26	8.96
Student-Direct								
Time 1	14.48	5.11	2.97	3.11	12.16	4.95	29.82	8.11
Time 2	6.76	2.18	9.72	9.07	26.21	5.32	41.29	7.07
Total								
Time 1	57.86	11.81	17.54	4.92	24.60	9.92		
Time 2	22.33	8.50	23.18	5.78	54.49	9.47		
Mean frequency counts of segments								
Time 1	61.4	8.05	18.6	2.60	23.9	2.37		
Time 2	18.1	2.35	18.7	2.09	43.8	4.14		

($M = 29.93$, SD = 5.22 at Time 1; $M = 30.26$, SD = 8.96 at Time 2) in comparison to the dominant teacher-direct regulation at Time 1 ($M = 40.06$, SD = 8.17) and student-direct regulation at Time 2 ($M = 41.29$, SD = 7.07, see Table 4).

Shift in the phases of SRL targeted

Consistent with Winne and Hadwin's (1998) model of SRL, we found a shift in discourse focus across phases of SRL. There was a

Table 5. Paired Sample *t*-test results comparing phases of SRL at time 1 and 4

	Task definition	Goal setting/planning	Enacting strategies	Total
Teacher-Direct	6.33*	n.s.	n.s.	2.96*
Co-regulation	6.73*	n.s.	−4.26*	n.s
Student-Direct	4.55*	n.s.	−7.02*	−5.38*
Total	12.57*	n.s	−8.18*	

*$\alpha = 0.05$, Bonferroni adjustment for 15 tests, $p = 0.05/15 = 0.003$.

statistically detectable decrease in dialogue targeting task definition from Time 1 to 2 ($t = 12.57$, $p < 0.003$, $d = 3.01$) and a statistically detectable increase in dialogue targeting strategy enactment ($t = -8.18$, $p < 0.003$, $d = 3.01$) (see Table 5). However, the incidence of goal setting/planning targeted dialogue remained fairly consistent from Time 1 to 2. Results of 16 paired sample *t*-tests, with Bonferroni adjustment to alpha (c.f., Howell, 2004), confirmed this pattern was consistent, regardless of who was initiating the regulatory activities (teacher-direct, co-regulation, student regulation).

Shift in the facets of SRL targeted

Findings supported the hypothesis that discourse targeting cognitive facets of SRL would become less prevalent, and metacognitive facets would become more prevalent as students developed experience and proficiency with the task. Table 6 provides descriptive statistics of a shift in each facet across time; Table 7 shows the summary of the statistical analysis. There was a statistically detectable decrease in dialogue targeting cognition from Time 1 to

Table 6. Means for appropriation of SRL by facets of SRL

	Cognition		Behavior		Metacognition		Motivation	
	M	SD	*M*	SD	*M*	SD	*M*	SD
Teacher-Direct								
Time 1	23.76	6.29	13.70	5.49	2.12	2.43	0.69	1.07
Time 2	8.52	5.99	15.65	7.09	3.78	3.15	0.11	0.35
Co-regulation								
Time 1	21.78	5.63	4.67	1.94	3.23	2.91	0.09	0.31
Time 2	9.60	4.40	12.13	5.96	9.00	3.45	0.71	1.19
Student-Direct								
Time 1	14.42	5.27	9.22	4.77	4.22	2.40	1.47	1.86
Time 2	8.81	5.81	18.07	6.56	12.41	4.78	1.20	1.17
Total								
Time 1	59.96	10.10	27.60	7.48	10.18	4.76	2.26	2.41
Time 2	26.92	10.26	45.85	10.07	25.19	6.18	2.03	2.07
Mean frequency counts								
Time 1	62.8	7.52	28.3	2.87	10.1	1.43	2.70	0.95
Time 2	20.2	2.39	39.4	3.19	19.4	1.77	1.60	0.60

Table 7. *t*-test results comparing facets of SRL from time 1 to 4

	Cognition	Behavior	Metacognition	Motivation
Teacher-Direct	6.62*	n.s.	n.s.	n.s.
Co-regulation	5.41*	n.s.	−4.28*	n.s.
Student-Direct	n.s.	−5.31*	−5.33*	n.s
Total	13.45*	−6.03*	−9.27*	n.s.

*$\alpha = 0.05$, Bonferroni adjustment for 12 tests, $p = 0.05/9 = 0.003$.

Time 2 ($t = 13.45$, $p < 0.003$, $d = 3.25$) and a statistically detectable increase in dialogue targeting behavior ($t = -6.03$, $p < 0.003$, $d = 2.06$) and metacognition ($t = -9.27$, $p < 0.003$, $d = 2.72$). However, no significant change in motivational focus in teacher–student dialogue was found (see Tables 6 and 7). Specifically, there was a decrease in teacher-direct regulation of cognition ($t = 6.62$, $p < 0.003$, $d = 2.48$) and co-regulation of cognition over time ($t = 5.41$, $p < 0.003$, $d = 2.41$), and an increase in co-regulation ($t = -4.28$, $p < 0.003$, $d = 1.81$) and student-direct regulation of metacognition ($t = -5.33$, $p < 0.003$, $d = 2.17$).

Discussion and conclusions: regulatory activity demonstrated by teachers and students across phases of SRL

We examined the ways students and teachers regulated or co-regulated learning during these portfolio conferences. To date, we know very little about how to support, or co-regulate, across each phase of self-regulation (task definition, goal setting/planning, or enacting of strategies). The present study, then, provided us with a window for sophisticated scaffolding techniques. Our findings partially supported our hypotheses that (a) in teacher–student dialogue about a complex task, teacher's fading from the dialogue would occur, (b) teacher's support and fading of support would be calibrated to specific phases of the self-regulatory process at a given point in time, and (c) techniques used for scaffolding and fading scaffolding would be directed toward specific phases and facets of the self-regulatory cycle.

Table 8 includes a summary of all the ways teachers and students directly and indirectly regulated SRL across each phase of SRL.

Table 8. How phases of SRL are regulated

Regulation appropriation	Task definition	Goal setting/planning	Enacting
Teacher-direct	Acknowledges difficulty T	Demonstration or Example T	Demonstration or example T
	Answers question T	Suggestion T	Judgment s (learning/performance) T
	Judgment s (learning/performance) T	Instruction/information T	Supportive statement T
	Elaboration/explanation T	Sets goal T	Instruction/information T
	Provides Instruction/information T	Reminds or refers T	Elaboration/explanation T
	Reminds or refers T		Reminds or refers T
	Restates or summarizes T		Restates or summarizes T
	Supportive statement T		
Teacher-indirect	Prompt T	Makes suggestion T	Refers T
	Reminds or refers T	Models thinking T	Request information T
	Restate or summarize or repeat T	Requests information T	Request judgment (learning/performance)T
	Requests confirmation T	Restates T	Requests confirmation T
	Requests information T		
	Requests interpretation T		
Student-indirect	Requests confirmation S	Makes suggestion S	Requests information S
	Requests information S	Requests confirmation S	Requests judgment (learning/performance) T
		Requests information S	Restates S
Student-direct	Indicates difficulty S	Provides explanation S	Example S
	Provides explanation S	Provides information S	Indicates difficulty S
	Provides information S	Sets goal S	Judgment of learning or performance S
	Reads S		Provides explanation S
	Self-talk S		Provides information S
	Records information S		Refers S

Teacher- and student-direct regulation

Not surprisingly, teachers directly regulated SRL by providing instruction or information, reminding students about earlier information and referring students to resources. These approaches were consistent across all three phases of SRL. In parallel, students directly regulated learning by providing information and elaboration across all three phases of SRL. Students also demonstrated that they were directly regulating learning when they made judgments of their own learning or performance. In many ways, students appropriated self-regulation across phases by adopting strategies and techniques used by teachers when they were regulating the same phases.

Co-regulation (teacher– and student-indirect regulation)

Similar to the literature on tutoring (e.g., Person & Graesser, 1999) and discourse patterns for peer mediated learning (King, 1999), questioning played a major role in teacher attempts to indirectly regulate learning across all three phases of SRL. Teachers frequently requested information or interpretation of the task, student goals, and their actual enactment of strategies. In contrast to the tutoring literature, which focuses primarily on the tutor's role, our study also considered other forms of co-regulation including student-indirect regulation. Students indirectly regulated learning by directing requests to the instructor that were similar to requests instructors made of students. For example, students requested information and elaboration about the task and goals. They requested judgments of performance and learning. In these instances, students recognized that they needed some help and asked questions specific to each phase of SRL.

Examining teacher–student discourse as a means for developing pedagogical agents that can support student's SRL

Hypermedia and multimedia environments often engage students in complex learning activities. Students are confronted with a wide array of information presented through various media, including text, video, audio, images, and animations. Perry (1998) suggests SRL can best be promoted in learning contexts that provide choice over challenge and task, provide instrumental support, and promote reflection and self-evaluation. Since hypermedia and multimedia environments provide many opportunities for choice over challenge, task, and direction, the challenge for educational technologists is to

design tools that augment that challenge and task complexity with instrumental support and opportunities for self-evaluation.

To date, a few studies have examined how teachers scaffold SRL in the context of computer supported learning activities. Azevedo et al. (2004) examined the effectiveness of adaptive scaffolding provided by a tutor when students were learning of complex science topics with multimedia. They found that adaptive scaffolds facilitated a shift in learner's mental models significantly more than a set of fixed scaffolds or no scaffolds at all. Fixed scaffolds consisted of a list of subgoals to be followed during learning. Karasavvidis et al. (2003) found that teacher's supportive discourse (akin to adaptive scaffolding) differed when students completed a task on the computer versus paper and pencil.

Recent studies (Azevedo & Cromley, 2003; Biemans & Simons, 1995; Kao & Lehman, 1997; Kramarski & Hirsch, 2003) demonstrate that adaptive scaffolding in biology, geography, algebra, and statistics leads to enhanced student understanding in hypermedia environments. However, designing and developing computer-based pedagogical agents that monitor and adaptively guide metacognitive and self-regulatory processes still poses challenges because we do not know enough about (1) *what* kinds of scaffolds are effective, (2) *when* to scaffold during learning, and (3) *how* to scaffold in order to facilitate students' learning of complex topics. This paper is not about computer-based learning environments (CBLEs). Instead, it addresses a problem identified by Puntambeker and Hübscher (2005) that contemporary technologies for scaffolding consistently over-emphasize the applications of tools and under-emphasize scaffolding interaction that involves diagnosis, calibration, and fading. In this paper, we shift the focus to naturalistic scaffolding interactions to understand how to diagnose, calibrate, and fade supports for SRL. This work was done with an eye toward designing pedagogical agents that guide, rather than instruct, self-regulation.

Socio-cultural theories suggest that regulation resides first with others (teacher-direct regulation), then becomes shared by teachers and students (co-regulation), and finally is appropriated by students as they take full control of their own regulation (student-regulation).

Our findings support a socio-cultural perspective of SRL demonstrating a transition from teacher to student regulation of phases and facets of SRL. These ten students appropriated self-regulatory control over time. Consistent with both socio-cultural and socio-cognitive perspectives of SRL, co-regulation in the form of teacher-indirect and student-indirect regulation played a mediating role in the appropriation

of SRL decreasing or fading out as students mastered particular phases and facets of SRL. Those same co-regulatory activities then became more prominent as students transitioned through other phases or facets of SRL. It is important to note that this type of dynamic fading in and fading out of instrumental support is consistent with Vygotskian notions of scaffolding. Scaffolds, in this sense, are not static tools built to stand alongside and support activity and then removed when the activity is complete. Rather, they are gradually adapted and morphed to changing shapes and needs in student's regulatory processes. For example, as students' appropriated regulatory behavior and thinking associated with task definition, co-regulatory activity and teacher directed activity did not cease all together. Instead, it was maintained at a much-reduced level in terms of the task definition phase, and re-directed toward other phases of SRL. This kind of dynamic movement across phases and facets of SRL is consistent with the dynamic and recursive nature of SRL and perhaps best supported with pedagogical tools dynamically adapted to students' self-regulatory competencies across both phases and facets of SRL.

Implications for developing pedagogical agents that can support SRL

While many contemporary instructional tools continue to emphasize scaffolding as a critical component of computer-based learning environments (e.g., Aleven & Koedinger, 2002) the types of scaffolds and the dynamic application of those scaffolds across time remain out of the purview of many of these tools. For example, technologies designed to deliver course material (e.g., Blackboard and Web CT) integrate a number of scaffolding tools such as collaborative communication tools, calendars, tools to help students track their grades, and organize course materials Yet these technologies overlook the role that diagnosis, calibration, and fading play in scaffolding instruction (Puntambeker & Hübscher, 2005).

Even Web-based pedagogical tools (WBPT) like those described by Dabbagh (2005) which aim to scaffold metacognitive skills like self-reflection, social negotiation, and self-observation do not take into consideration the way in which individual self-regulatory needs might moderate and mediate the effectiveness of those scaffolds. While research on strategic learning and computer-supported scaffolding is converging (Azevedo et al., 2005; Dabbagh, 2000; White, et al., 2005) our findings highlight the increasing need to calibrate learning support across a range of self-regulatory activities and phases.

Our findings have four implications for the design of computer-supported pedagogical agents with potential to assist in diagnosing specific problems and calibrating support to the appropriate phase of self-regulation. First, we must design pedagogical agents and other computer-supported tools for learning that target specific phases and facets of SRL. Drawing on King's (1999) work about discourse patterns for mediating peer learning, we might begin to explore the types of questions (e.g., requests for information, evaluation) that are characteristic of each facet and phase of SRL. This paper has taken initial strides to identify some patterns, although much more work is required in this area.

Second, we must direct pedagogical agents and tools toward attuning support to appropriate phases and facets of SRL at a given point in time. This means collecting precise data about the degree to which students have (a) accurate and complete understandings of tasks (task definition), (b) goals and plans in place for task completion and improvement, and (c) strategies for enacting the task. The kind of support, questions, and information students use and the degree to which students are ready to appropriate self-regulatory behavior and thinking can differ radically across those phases of SRL. It is not enough to provide static tools targeted at each phase of SRL (such as a progress report) because students need to learn to use those tools to enhance their own learning at a given point in time. It cannot be assumed that students progress through these phases in a linear fashion mastering one phase and then moving on to another. Our findings support Winne and Hadwin's (1998) model of SRL demonstrating that although the emphasis shifts away from earlier phases (e.g. task definition) as time progresses, it is continually revisited by students as they regulate learning.

Third, research needs to compare the effectiveness of static versus dynamic computer-supported tools for facilitating the appropriation of self-regulatory activity at different phases and across different facets of SRL. Consistent with the computer-based scaffolding literature that currently exists, we expect that some static tools will be adequate for some phases and facets of SRL. However, it is the introduction, adaptation, and maintenance of the more dynamic pedagogical tools that poses the greatest challenge to computer-supported learning environments. Perhaps computer-supported static tools for mediating peer interactions hold promise for dynamically supporting the appropriation of self-regulatory behavior and thinking. For example, tools to support student help seeking, and tools to mediate student learning through questioning (e.g., King, 1999) may

provide means for supporting peer mediated learning where questioning tips and scaffolds are provided both for knowing how to ask for help (taking on student-indirect role) and prompting students to regulate learning (taking on teacher-indirect role). In this way, peers dynamically regulate for one another, and engage in co-regulatory activities as they move toward appropriating self-regulation themselves. It is important to emphasize that in designing tools to support self-regulation. We must keep in mind that our goal to move away from doing the regulating for the learner and towards the learner's regulating for him or herself. For students in this study, this meant offloading self-regulatory behavior and thinking to others temporarily until students were ready to appropriate and direct their own self-regulation.

Finally, work still needs to be done in terms of designing measures of SRL that are sensitive to these dynamic changes in SRL across phases, facets, and time. Winne and Perry (2000), Perry (2002), and Pintrich (2000) have all identified the measurement of SRL as a challenge for the field. Examining SRL as a series of events over time is the only way to capture changes in both the appropriation of self-regulatory behavior and thinking, and changes in the type and degree of support that is useful for students at a given point in time. Good measures of SRL as a dynamic and emerging process provide necessary data from which to design pedagogical agents with potential to support SRL; these measures, however, are also necessary for examining the effectiveness of those same agents. Data from our study show that although patterns of appropriation of SRL across phases and facets emerged when we examined aggregated data (mean percentages of total activity), there also existed a great deal of individual variability. One of the characteristics of scaffolded instruction is that it is targeted to an individual students zone of proximal development. In this case, our goal should be to develop and measure the effectiveness of pedagogical agents that can target support to the individual's self-regulatory needs, rather than designing for an aggregated mean. This type of individualized support is only possible if we can measure and assess changes in student's self-regulatory development in a timely and efficient manner.

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Appendix A. Codes and Examples for SRL Ownership

Ownership category	Code	Description	Examples
Teacher-Direct	VF-T	*Vague Feedback*: No discernible meaning attached to utterance.	'Mm-hm'; yeah
	PI-T	*Provides Information*: Information directly provided regarding content, conference or data.	What we're [going] do today is we're going to work through some things you have for, for your portfolio.
	PEX-T	*Provides Explanation*: The reasoning or rationale for something is given; answers 'why'.	Part of this whole defining goal is so that we can see how you progress through the course,
	REF-T	*Refers*: Teacher refers students to course resources or tools such as course outline, portfolio assignment description, etc.	You've had a chance to read through the course outline. I have a copy of it here with me.
	REM-T	*Reminds*: Reminder about something that was done or learned.	You've had a chance to read that chapter and we talked in class about what your portfolio should be including.
	R-T	*Reads*: Reading is done directly from the portfolio, course outline, etc.	(Reading) To provide a means for setting your own learning goals, providing means for your self/monitoring and reflect upon your learning.
	PEL-T	*Provides Elaboration*: Extends or adds to previous explanation or comment.	Right, so they're not goals about other stuff.
	FA-T	*Focuses Attention*: Focuses attention on a specific concept or part of the portfolio; a way of trying to get the student to focus on the place where they might find the answer.	When you think, when, when you know that the portfolio is your, like you mentioned, your sort of your own individual process.

PJOL-T	*Provides Judgment of Learning*: Judgment of accuracy or completeness of performance, learning, performance or processes is provided.	Cause I think you actually have a better sense than you're thinking right now.
PEG-T	*Provides Example*: A specific example is provided to support or demonstrate learning, process, and/or performance.	[Like your goals don't have to be like a really big thing like] "I want to develop a research study that incorporates" you know.
PPF-T	*Provides Positive Feedback*: Teacher provides positive feedback such as good, great, etc.	Good; great;
PDA-T	*Provides Direct Answer*: A direct answer is given to a question; usually follows a sequence of scaffolding techniques that have been ineffectual.	They should be challenging, but they should be achievable. (Teacher providing a characteristic of a goal after ineffectually trying to lead the student to the answer.)
D-T	*Demonstrates*: Actual demonstration of what to do (e.g.) filling out progress report, recording goal, etc.	So, we put that achievable right (teacher writing in progress report).
SS-T	*Supportive Statement*: A statement made to encourage the student, or take the pressure of the situation.	Can you think, like just sorta off the top of your head, and I know it's sorta hard. Ya, it's tough, it's tough.
SG-T	*Sets Goal*: Teacher describes a useful goal for the student to implement to improve learning or performance.	and you're going to set some some goals for between now and the next time we meet for a portfolio conference about how you're going to do things different in your portfolio to help address this.

Appendix A. Continued

Ownership category	Code	Description	Examples
	JOP-T	*Judgment of Performance*: Judgment related to concrete tasks in portfolio, e.g. record of learning goal, progress report, etc. Occurs when documents are being reviewed.	and I think this, it might be a place where where you've done a really good job of this and your [going] feel this out later.
	FS-T	Teacher CORRECTLY finishes student statement.	S: And I redid my reflection twice so, [I'm] constantly ah, T: Revising
	AD-T	*Acknowledges Difficulty*: Teacher indicates explicitly that the student seems to be having difficulty understanding a specific task or concept.	It's a tough one cause you're not, you're not used to being evaluating your own work right?
	PI-T	*Provides Information*: Teacher provides direct instruction on how to complete a task. Usually to do with filing out progress report, what/when things should be handed in, etc.	So and then once you've had a chance to fill this out you can um, you sign it and then you bring it back to me.
Teacher-indirect	RI-T	*Request for Information*: Request is made for specific information regarding content or data.	Why do you think it's important that you have specific learning goals?
	RST-T	*Restatement*: Comment is paraphrased usually to connect it with the language or context of the class or task. Interpretation of other's comment; may just restate / justify the purpose of an explanation or example.	and you mentioned really showing that you were talking about progress.

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REL-T	*Requests Elaboration*: Request of an extension or addition to a previous explanation.	Okay, what does that exactly mean?
RJOL-T	*Requests Judgment of Learning*: Requests that the student evaluates or assesses their own learning and/or understanding.	Did you learn anything new?
PP-T	*Provides Prompt*: Tries to lead the student to the answer by: (a) starting a sentence and leaving it for the student to fill in, (b) requesting more information or to encourage the student to ask further questions.	You sort of touched on them when you were talking about =
PMP-T	*Provides Pump*: Teacher provides content free opening for student to elaborate or continue on. For example and..... or a hesitant confirmation like right.... spoken under the breath; utterance like 'oh'	oh...
S-T	*Summarize*: Big restate that tries to pull together the point of the earlier string of discussion; provides a general overview of dialogue	So, in talking about, in thinking about clearly defined learning goals, um it is really important that you express what those goals are' (summary of previous dialogue)
DR-T	*Delays Response*: acknowledges hearing the question but delays responding to it....tries to change the direction of discussion	'We can, we're [going] talk about that.'
MT-T	*Models Thinking*: The thought process (reasoning and rationale) is explicitly modeled; verbalizes thinking.	'Like you said, 'what steps am I [going] take to sorta try to get at some of those goals that I have for myself?' Um, in thinking about, about knowing that she's going to be looking for you to define some goals.

Appendix A. Continued

Ownership category	Code	Description	Examples
	MS-T	*Makes Suggestion*: Makes a suggestion about how to organize the portfolio; usually involves the word maybe, why don't you/we, etc.	So why don't you just do it by theme?
	RJOP-T	*Requests Judgment of Performance*: Requests that the student examines the strengths and/or weaknesses of the portfolio assignment; occurs when referring to portfolio tasks specifically not just learning in general.	Find places where you think you've done a real-, you- sort of a strength where you've done a good job of defining your learning goals...and maybe a place where you haven't done such a good job..''
	MLS-T	*Models Learning Strategy*: Models a useful strategy for remembering information, distinguishing between criteria, or completing a task.	and this is sort of one of the ways I sort of try to help myself to keep track of it. This is like a telling, this is a showing and this is describing how.
	VF-S	*Vague Feedback*: No discernible meaning attached to utterance.	'Yeah'; okay (spoken softly)
Student-direct	PI-S	*Provides Information*: Provides information on any aspect of the portfolio e.g. organization, criteria, progress report, etc.	'What the portfolio is for, um, I would think so we can reflect on ah, on our learning,'
	REF-S	*Refers*: Student refers to course resources or tools such as course outline, portfolio assignment description, etc.	well, it says here 'to show growth or change over the semester.'
	R-S	*Reads*: Reading is done directly from the portfolio, course outline, etc; or directly from the student's portfolio.	Um, ''student performance'' (reading)

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PEL-S	*Provides Elaboration*: Extends or adds to previous explanation or comment.	[Reflection probably] like if we make a mistake, how we correct it.
PJOL-S	*Provides Judgment of Learning*: Judgment of accuracy or completeness of performance, learning, or processes is provided.	Yeah, that was very vague though.
PEG-S	*Provides Example*: A specific example is provided to support or demonstrate learning, process, and/or performance.	Okay, like what the goal of the class is.
SQ-S	*Self-questions*: Student asks a question to themselves in order to monitor understanding or quality of what they said or wrote or said.	'Um, what else?'; What is the purpose of this research portfolio?
RI-S	*Records Information*: Student writes information down in progress report, margins of portfolio content, etc. as a strategy to remember what was discussed regarding portfolio assignment or course content.	(Transcription will indicate that student was writing or it is apparent from the dialogue.)
SG-S	*Sets Goal*: Student sets a goal (based on previously learned information); this goal can be in reference to portfolio organization, fulfilling criteria, etc.	/but, I know like, I have to go get my articles and do the summaries and once I can get that, I can put a summary in.
JOP-S	*Judgment of Performance*: Judgment related to concrete tasks in portfolio, e.g. record of learning goal, progress report, etc. Occurs when documents are being reviewed.	Ya, it was very vague though; So that's a good question!?
FS-S	*Finishes Statement*: Student CORRECTLY finishes teacher statement	T: You've got pilot [testing]- S: [pilot testing]

Appendix A. Continued

Ownership category	Code	Description	Examples
	ID-S	*Indicates Difficulty*: Student explicitly indicates a difficulty in task understanding, in terminology, in explanation, etc. This can be expressed in tone (e.g. confused tone)	I don't know, I don't know how to explain.
	RCNF-S	*Requests Confirmation*: Student requests from the teacher a confirmation of their accuracy of understanding (response, description, explanation).	Is that correct?
Student-indirect	RI-S	*Requests Information*: A request is made for specific information regarding content or data.	'Are we [going] include in the portfolio all the papers we're [going] be doing like?'
	REX-S	*Requests Explanation*: Student wants to know more about the reason or rationale, that is, an interpretation of what is being said as opposed to an extension or elaboration.	'The goals part I don't understand much.'
	RST-S	*Restatement*:Comment is paraphrased usually to connect it with the language or context of the class or task.	So I wouldn't include this whole thing.
	RJOL-S	*Requests Judgment of Learning*: Student requests that the teacher evaluates or assesses student's learning and/or understanding	I guess I could define in my portfolio how I plan on achieving these objectives, do you think?

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S-S	*Summarize*: Big restate that tries to pull together the point of the earlier string of discussion; provides a general overview of dialogue; also used to indicate the end of information to share. e.g. That's basically what I have (or) That's primarily what I think. (This is significant because the student is monitoring their response to the question (indirect regulation).	Basically I think that's what you're doing.
MT-S	*Models Thinking*: Student models the thought process they have gone through or uses this strategy to 'practice' strategies/suggestions shared in the conference.	Like as I was doing these things I'm like "oh my god am I self/regulating learning?" Like [[you know am]] I a self/regulated learner here?
MS-S	*Makes Suggestion*: Makes a suggestion about how to progress with portfolio, meet criteria, etc.	So what I could do is bring an example of how I did a proper search? And then I could bring my articles in.....
RJOP-S	*Requests Judgment of Performance*: Student requests that the teacher examines the strengths and/or weaknesses of the portfolio assignment. Occurs when referring to portfolio tasks specifically not just learning in general.	Um, I have a, like, I'm thinking of something to do to add to the portfolio but I don't know if its appropriate.
RRST-S	*Requests Restatement*: Request is made to repeat information usually in order for the student to write down as a reminder; confirming or clarifying understanding by having the other restate.	What did you- can you say that again.

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Note

[1]An alpha level of .05 was used for all statistical tests and the Bonferroni procedure was applied to adjust for the number of tests. Adjusted *p* values are reported throughout.

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