Capturing Rehearsals to Facilitate Reflection

Meltem Albayrak
Brian K Smith
Pennsylvania State University

Introduction

Many learning environments involve rituals for rehearsal and reflection. Musicians, for instance, spend countless hours practicing scales and adjusting their bodies to increase their skills. But they do more than simply practice: They also play for instructors and others who can provide valuable critiques of their performances. Architectural design studios encourage students to create designs and share them with experts and peers in organized "crit" sessions that point out good and bad aspects of their work. Athletic coaches often watch videos of games with their players to reflect on issues for improvement. In all cases, there is a cycle of skill rehearsal followed by periods of critical reflection to understand successes and failures, ultimately to improve future performance.

Much of reflection is about making tacit knowledge and routines explicit so they can be analyzed and promote self-awareness or "knowledge-in-action" (Lin et al., 1999; Schon, 1983). In the above examples, these reflections are partially facilitated through concrete artifacts that capture aspects of past performance. Musical sessions can be recorded to tape, architecture students create drawings and models, and athletes use video when reflecting on their skills. Otherwise transient actions and performances are captured and made explicit as concrete artifacts for reflective thinking and learning.

Our research considers the importance of making actions into artifacts for reflective thinking. In particular, we will describe ongoing efforts to develop computer-based visualizations for diabetes health management. Approximately 17 million American suffer from diabetes (NIDDK, 1998), and those numbers continue to increase. The disease cannot be cured, but it can be managed through insulin and oral medications and changes in diet and exercise habits. We are focused on the latter part of diabetes self-management, the regulation of daily routines to prevent abnormal blood sugar levels that could lead to future health complications.

Most diabetics carry and use glucose meters, small, handheld devices that measure and report current blood sugar levels. These technologies are critical to diabetic lifestyles, as they present physiological data to help people see *how* they are dealing with the disease. Our research tries to add additional information to glucose meters by helping diabetics explore questions about *why* their sugar levels are normal or abnormal during the day. Specifically, we developed a computer-based visualization for displaying glucose meter data that makes patterns of regularity (or irregularity) explicit to its users. The hallmark of these visualizations is the use of color to provide global overviews of high, low, and normal blood sugars over extended periods of time.

Beyond visualizing physiological data, we have diabetics take photographs of their daily activities, focusing on things that might impact their blood sugar levels. These images are integrated into the computer visualizations to contextualize the numerical data. Our hypothesis was that diabetics could begin to engage in reflective thinking around their health practices when provided with visualizations that point out potential correlations between blood sugar levels (captured by glucose meters) and behaviors (captured in photographs). We will report results from a recent study of the use of visualizations of behavioral and physiological data to enhance the aspects of reflection stated in findings

Definitions of Reflection

Reflection has been defined differently by different people. Before analyzing our study data we considered the following definitions.

In a chapter in *How We Think* (1997), entitled "What is Thought?". Dewey defines and emphasizes the importance of reflective thought. Reflective thought is one of the four senses of thought: the process of accepting a belief after deliberately seeking and examining its grounds. Reflection involves the consequences of ideas rather than merely a sequence of ideas. Each created idea is a link in a chain of ideas. The important consequences of beliefs or behaviors might force one to consider the reasons for these and come to a "*reasoned conclusion*". Reflective thought is the "*active, persistent, and careful consideration of any belief or supposed*

form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends" (Dewey, p. 6). Reflective thinking has two elements or subprocesses: "a state of perplexity, hesitation, doubt" and an investigation to confirm or refute the further facts (Dewey, p. 9). In other words reflective thinking starts with facing a problem or questioning and then continues with efforts at solving the problem by reasoning. The process ends with a reasoned conclusion which would be the start of another reflective thinking process. Dewey concludes that reflective thinking "… means judgment suspended during further inquiry; and suspense is likely to be somewhat painful." (1997, p. 13)

Schon's definition of reflection comes with the following terms: knowing-in-action, reflection-in-action and reflection on action-in-action. Knowing-in-action refers to the kind of knowing that is revealed in our intelligent action while executing a spontaneous performance (Schon, 1987). This is a kind of action that cannot be verbalized. The knowing occurs in the action as a response to an unexpected outcome. The unexpected outcome can be result of anything that does not happen as a part of routine. Further knowing-in-action may help us to reflect on the unexpected outcomes of daily routine and take an in action. For example, automatically steering a bicycle to the left in order to maintain balance whenever the bicycle tilts to the left is an example of reflection-in action, The action which occurs in that present moment as a response to the unexpected results from and demonstrates knowing-in-action. During an action, we still can make a change to the situation and our thinking serves to reshape what we are doing while we are doing. In cases like this, we reflect-in-action, "thinking on our feet" (Schon, 1983, p. 54). For example one bikes to the left naturally when the bike tilts to the left at the moment of in-action. When we think back to see how our knowing-in-action helped us respond to the unexpected situation, then we are reflecting *on* action. Reflection on action can help reveal our own theories as well. When one finds himself experiencing puzzlement, or confusion in an uncertain or unique situation, "he reflects on the phenomena before him, and on the prior understandings which have been implicit in his behavior (Schon, 1983, p. 68). This experience results in generating "both a new understanding of the phenomena and a change in the situation" (Schon, 1983, p. 68).

Self-reflection and reflection are the terms defined as a part of self-regulated learning (SRL) by Zimmerman and Pintrich (Puustinen & Pulkkinen, 2001). Zimmerman (1998) defines self-regulated learning as a cyclical process which has three components: forethought, performance and self-reflection. Each of these components support each other in a sequence. Further more specifically self-reflection has four types of processes: self-evaluation, attributions, self-reactions and adaptivity. As one of the initial processes during self-evaluation, one compares self-monitored information with a goal. Self-evaluation leads one to attributions of reasoned conclusions. Attributions lead one to self-reaction and also to adaptation to the performance. Similarly, Pintrich's SRL definition has reflection as one of the four phases, whereas the first three are forethought, monitoring, control and reflection (Puustinen & Pulkkinen, 2001). More "reflection includes cognitive judgments, affective reactions, making choices and task and context evaluation".(Puustinen & Pulkkinen, p. 274)"

Study described

Specifically, our study involved six type I diabetics and one type II diabetic. This group took photographs of their everyday activities for a month and met with us weekly to discuss their health, using their visualized data as a conversational prop (Brinck & Gomez, 1992; Roschelle, 1992) for reflection.

They were given small digital cameras and asked to take pictures of diabetes-related behaviors. The diabetics were free to decide what they would take pictures of. We suggested that they might take pictures of their meals and exercise activities. In their daily activities they were testing and monitoring glucose results by using a digital glucose tester.

Before each weekly meeting, we uploaded the glucose data and the pictures to the computer. Then we displayed the data with software which was created for this purpose (see Figure 1 and 2). With this interface we could see the glucose results and diabetes-related activities, captured in pictures, accompanied by a record of the time and day. For the glucose results, color codes were used in order to facilitate an easy and quick grasp of glucose patterns. The colors represented ranges of blood sugar levels as follows:

- Dark blue: 0-39
- Lighter blue: 40-80
- Gray: 81-120
- Red: 121-140
- Dark Red: 141 and higher

The data for the entire period were displayed and then we posed questions to facilitate reflection. When

necessary, the pictures were magnified (see Figure 3).

What follows is a discussion, based on preliminary data analysis, of the experience of the participants and how it helped them reflect.

Findings

Schon claims that his examples of a baseball pitcher who reflects on "winning habits" and a jazz musician who reflects on the experience of making music, show that "reflection tends to focus interactively on the outcomes of action, the action itself, and the intuitive knowing implicit in action" (1983, p. 56). In our study, participants were invited to focus on the outcomes of activities related to being diabetic, activities by themselves and the intuitive knowing implicit in activity. Before taking photos of activities they had to focus on the outcomes of the activities related to diabetes. For example, how does this exercise affect my glucose? Most of them took pictures of their meals and exercise activities such as walking and weight-lifting. In the process of capturing activities the participant experiences the intuitive knowing implicit in the activity. The participant makes this implicit knowledge explicit in two ways. The participant makes the knowledge explicit by communicating via visual representations of captured activities, photos and also by talking about them later on during the interviews. The knowledge is received by two parties: the participant and the interviewer who in some cases could be a health care person or physician.

In our study we could see how reflection occurred differently for different participants. When we consider a consensus over given definitions of reflection above and the outcomes, we could see four phases in our study. These phases were cyclical, temporally overlapping only somewhat linear. They corresponded to key concepts emerging from the definitions.

1. confusion, perplexity, hesitation, doubt, unexpected outcome, judgment suspended
2. judgment suspended, investigation, monitoring, self-evaluation, context evaluation, reasoning, persistent and careful consideration, knowing-in action, reflection-in action
3. reflection-in-action, reflection on reflection-in-action, new-understandings, confirm/refute the facts/conclusions, affective reactions, making choices and tasks
4. making choices and tasks, changes

Following we will introduce our preliminary data results associated with these phases.

Participants' awareness about what to do was extremely variable. Most of the participants know what to do in general for their health care. P108, who was an athletic, had already come to an understanding through past experience of what affects her blood sugar and how to deal with it by correlating her eating and exercise. She had been exercising couple of times per a week since her childhood. She kept log books recording of what she ate and what she did for exercise. She thinks she does not have room to improve much. In other words, she does not have much confusion in her diabetes-related life. However she still is not sure about some blood sugar changes that specifically occur due to exercise. She still has not found the reasons of this. This is still a puzzle to her. When we asked what she learned about herself during the study, she answered:

"…I don't think I learned anything new…because I am an athlete and I have been at least recently really looking at my diabetics what affects it and how to change it, kind of understanding myself more what the exercise does to my health aham I think I have already gone that process but if maybe the other people haven't aham that they don't really understand what affects it as much it might help them for a better understanding. Since I wrote down everything I eat what insulin I take, I can sort of already look back and see what affects more…I have a basic understanding but some things are still different like I said exercise will kick in at strange times, some times directly after sometimes later which I am still trying to figure out…for some reason one day my body would kick in earlier or later" (P108, interview4, conscious, 1:36)

On the other hand some of the participants still did not know what causes what. They were still in confusion or hesitation. And knowing the reasons for changes could be helpful for P106.

"…I hope to see what it is causing me to get high blood sugar…but if I see what is causing me that would definitely be direction…" (P106, interview1, conscious, 20:03)

Even though they know, what they do or they do not do to manage their diabetes has already become part of their daily routine. They may not be thinking about their diabetics-related experiences enough because they have become repetitive practices embedded in their daily routines. For example, Schon (1983, p. 61) mentions that when practice becomes more repetitive and routine, knowing becomes sufficiently implicit and natural that the practitioner may miss important opportunities of careful consideration of what he is doing. By asking participants to capture their diabetes-related behaviors, we invited them stand outside of their routine lives and think actively, persistently and carefully about what they are doing for their health care as they are

doing it (thinking on their feet). As a result of experiencing their lives out of their routine by wearing different lenses which comes with the study requirement, capturing behaviors, they could reveal their knowing-in-action and then reflect in-action.

For example P109 was not sure about the reasons for his high glucose measures and he was having suspended judgment:

"…I think with this really high one I had a big dinner that evening that could have been of the causes of that…aham I know for most of the high ones they come after meals…that could be something to do with eating a meal right before that that could be why they are high…" (P109, interview1, conscious, 24:58)

and he was reflecting-in-action by facing the problem that needs to be fixed but not having the solution/ response yet:

"…I think now looking at the blood sugars that there are a lot of higher ones which something needs to be fixed…" (P109, interview1, conscious, 27:02)

While monitoring the two-week data on our second interview, he continues reflection-in-action, advantageously, this time he realizes some patterns on his high glucose results in the mornings and questions the reason. He wants to know the reason. This is still reflection-in-action, investigation, since there is an inquiry but he does not respond to the problem yet.

"…I think I need to trying get my blood sugar under control especially in the mornings. I have to figure out what is causing that." (P109, interview2, conscious, 56:37)

P107 started living a different life when she left home and became a college student. This new life brought her some perplexity and suspended judgment regarding her diabetes management. We can see her experience of four phases at the same time: doubt, context evaluation, making choices and changes.

"…(her doctor) said they should have nutrition facts up there stuff, they do have that for a lot stuff but I eat a lot at the salad bar and they don't have that stuff up so unless I go and bug somebody in. I tried to looking up on the Internet…now just trying judging…now I am trying…I better go low then high but it is hard to the fact that at home I think I could manage my diabetes better…here my schedule I mean everything is so different every day is different and I am walking everywhere so that's why it is much easier to control at home…" (P107, interview 1, as a student-nutrition, 16:29)

"…I have been a lot more conscious about how to cover my meals…they don't have carbs in the dining hall…so I am trying to guess and it is the reason why sometimes it is high or low…so I have been trying to eat more regular salad dressing not fat-free" (P107, interview1, conscious, 04:17)

Choosing the regular salad dressing shows her solution. She has a problem and responds to that problem while it is occurring. She is reflecting-in-action and also making choices and changes.

Monitoring the glucose data and captured activities supported the participants on their investigation. For example both P109 also P110 observe how their eating amounts affect their blood sugars by monitoring the patterns on the visualized and color-coded data. They noticed that their glucose level was high in the mornings as well. More, some of them stated some new understandings of their life:

"..It was interesting to see what kind of habits I have. Maybe I realized what I should do a little bit more…Like I really never thought about sleeping how it affects my sugar…" (P105, interview4, conscious, 36:27)

"…this is interesting because I don't usually view as stress affecting me much but you guys said anything affect my blood sugar level that I could feel it…like affecting me and I don't usually give that much" (P106, interview1, conscious, 10:14)

"…I just became more aware like at the gym…this is first time I kept a log book for a long time it kind of helps seeing the pattern…"(P107, interview3, conscious, 12:21)

Monitoring also helped for realizing some habits, self-evaluation and followed with confirming the fact:

"…I took a picture of glucose tablets…aham let me see…geez I don't why I ate glucose tablets. I just eat them sometimes when I feel low…well that's even normal to deal with …we (then he sees the pictures and says) yeah I am actually starting to remember this day I ate a lot…I ate what ever I want…then I try to compensate with extra insulin which is not good idea I am trying to learn more on that, me myself…" (P106, interview3, conscious, 30:30)

After investigation confirmation emerged. Some participants noticed or confirmed that different kinds of exercising such as walking versus weight lifting affects blood sugar drops differently. For example P108 mentioned that weight lifting kind of activities affect later rather than just immediate after. She already had an awareness of that. On the other hand P109 was not sure of this and had an idea about that when questions prompted him to see a correlation:

"…maybe weight lifting is affecting the next day more than the same day…" (P109, interview4, conscious, 45:47)

"…I think we saw a connection between exercise and the next day blood sugar seems to be lower in the morning the day after exercise. I think it is one pattern that we saw. Seems that if I have a big dinner I don't know how to adjust (?)…"(P109, interview4, conscious, 51:05)

When asked to provide the reasons for the fluctuations by monitoring the data, one participant responded,

"…Aham there could be a lot of different reasons of that. For instance if I am taking the insulin or I am taking too much insulin or eating I have noticed depending on what eat has different effects. like if I eat pizza or something the effects of that don't really impact me until like two hours later." (P111, interview 3, measures-fluctuations, 36:46)

In the fourth interview when the color-coded data viewed P111 realizes changes:

"…I see a significant improvement in the back last five days…"

and then he comes to some conclusions when he is asked to see the connection between his exercise and blood glucose data:

Interviewer 1: "…when you look all overall this data and do you see connection between your exercise and blood glucose data?"

P111: "definitely"

Interviewer 1: "how?"

"…aham I think (?) last week (?) shows and from when I work as well shows that my blood glucoses decreases dramatically so if it doesn't decrease dramatically immediately if it doesn't immediate effect like from running or something aham symptoms of it will definitely show up in the morning rather than at night and from I think from work since work is usually a longer period than a few hours you see the results of working of when I finish working my work I test my blood and you see the results…" (P111, interview 4, reflection-on, 22:48)

Ultimately, some participants reported some changes or considerations of changes in their life. After they responded to the problem and then reflected on that. Some participants increased their exercise with more walking or decreased eating non-recommended food. For example P111 stated that he stopped eating ice cream, or P110 tried to increase his exercise (walking) and decided not to eat late at night. P111 is talking on the experience of the study:

"…it was definitely a positive experience just because of the fact that I just had to be consciously aware of yeah I need to take picture of this and sometimes it is a horrible (deter?) but sometimes I think that 'do I really need to eat this?'because I am gonna take picture of it. I think it it definitely helped just making me conscious of what I eat…" (P111, interview4, DPS-taking pictures-stops more eating, 31:19)

Interviewer 1 follows: "Do you think it affected your choices of eating?"

"…yeah a few times it did…like for instance this whole past last two months like I have not eaten any ice-cream which is very weird considering that I love ice-cream and I am in the Penn State (referring the popular ice-cream place)..." (P111, interview4, DPS-taking pictures-stops more eating, 31:19)

"…I have improved the numbers (blood results)…it is definitely worked a lot…" (P106, interview4, conscious, 43:31)

Interviewer 1 asks: "This experience have helped your health?"

"…this just made me realize I am pretty out (?) of control now…so many little things make big differences…I am trying to get under control I guess…" (P107, interview4, conscious, 4:00)

Limitations and Conclusion

One of the limitations was the interviewers' lack of expertise on the content. The interviewers were not health experts, so that could have decreased their ability to see the correlations between the data and the disease. Further, some questions asked by the interviewers to facilitate seeing the impact and correlation could affect the statements given by the participants. More the tendency of pictures on the subjects of eating and exercise could have been the result of examples given by the researchers at the beginning of the study. In addition to these, we had some technology-related limitations. The camera was forgotten or inconvenient to carry for some participants. One participant mentioned that it would be better to have camera and the monitor together in one tool, since she already has to carry the monitor. Also a few comments were made about how difficult it is to communicate everything by taking pictures. One participant found writing log books easier while some others found taking pictures easier.

Further applications and research of this study might be in various areas for various purposes. In

general, this could be used for reflection processes as a path to improvement. Facilitating active, persistent and careful consideration of lived experiences by thinking about captured and monitored activities might help one to improve. We can see applications in health for complex disease diagnosis, adaptation and management. The study also has broader educational applications because it describes and evaluates a form of self-regulated learning.

References

Brinck, T. & Gomez, L.M. (1992). A collaborative medium for the support of conversational props. In *Conference Proceedings on Computer-Supported Collaborative Work* (pp. 171-178), New York: ACM Press.

Dewey, J. (1997). *How We Think.* Dover Publications, Inc.

Lin, X., Hmelo, C., Kinzer, C.K., & Secules, T.J. (1999). Designing technology to support reflection. *Educational Technology Research and Development, 47*(3), 43-62.

NIDDK. (1998). *Diabetes Overview* (NIH Publication No. 96-3873). Bethesda, MD: National Institutes of Health.

Puustinen, M., & Pulkkinen, L. (2001). Models of Self-regulated Learning: a review. *Scandinavian Journal of Educational Research, 45*(3), 269-286.

Roschelle, J. (1992). Learning by collaboration: Convergent conceptual change. *The Journal of the Learning Sciences, 2*, 235-276.

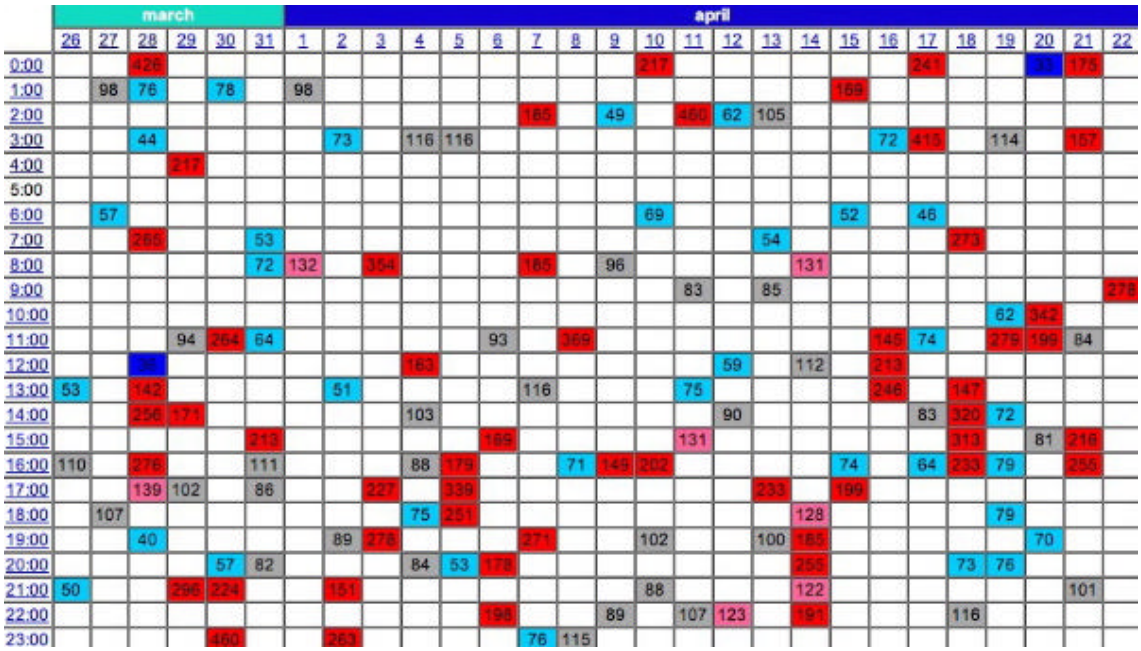
Schon, D.A. (1983). *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Books.

Schon, D. A. (1987). *Educating the Reflective Practitioner: Towards New Design for Teaching and Learning in the Professions*: Jossey-Bass Inc., Publishers 350 Sansome Street San Francisco, CA.

Zimmerman, B. J. (1998). *Self-regulated learning : from teaching to self-reflective practice*. New York: Guilford Press.

Graphics

Figure 1: Glucose results on color-coded chart



	march						april																				
	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0:00			426													217							241				175	
1:00		98	76		78		98														169							
2:00													165		49		466	62	105									
3:00			44					73		116	116											72	413		114		157	
4:00				217																								
5:00																												
6:00		57														69					52		46					
7:00			266			53													54					273				
8:00						72	132		354				165		96					131								
9:00																	83		85									278
10:00																									62	342		
11:00				94	264	64						93		369								145	74		279	199	84	
12:00										163								59		112		213						
13:00	53		142					51					116				75					246		147				
14:00			256	171						103								90					83	320	72			
15:00						213						165					131							313		81	216	
16:00	110		276			111				88	179			71	149	202					74		64	233	79		255	
17:00			139	102		86			227		339								233		199							
18:00		107								75	251									128					79			
19:00			40					89	276				271			102			100	165						70		
20:00					57	82				84	53	178								255				73	76			
21:00	50			296	224			151								88				122							101	
22:00												198			89		107	123		191				116				
23:00					460			263					76	115														

Figure 2: Glucose results and pictures taken

Figure 3: A magnified view of a picture