

Articulating Science Teachers' Values and Convictions for Teaching Socioscientific Issues: Based on Essentialist Methodology

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Abstract: This paper has two major purposes. One is to introduce the essentialist methodology as a way to articulate subjective aspects of human beings (e.g. teachers' personal values and concerns, philosophies, subjective experiences, etc.) at a deeper level. And the other is to present two portraits, as examples, of science teachers who actively address socioscientific issues (SSI) out of their own motivations. The primary data source was consecutive in-depth interviews with two science teachers, Jenna and Thomas, and the interviews were conducted on the basis of the principle of the "participant as ally" (Witz, 2006). The articulation based on the essentialist methodology shows that teachers' deep-rooted values and convictions often play a significant role as a personal social capital enough to expand their teaching practice (i.e. teaching SSI). Namely, this study confirms that teachers who are motivated out of their own convictions are likely to actively develop their own personal practical knowledge, and to implement particular topics or teaching strategies.

Key words: Portraiture, portrait, essentialist methodology, socioscientific issues, SSI, science teacher, teacher inspiration, qualitative research, teacher value

I. Introduction

Analysis of a teacher's self-understanding, larger values, social awareness, and worldview may help to "understand numerous details of how that teacher would relate to new educational approaches" because these are "important factors affecting their teaching practice and personal and professional growth and development" (Witz *et al.*, 2001, p. 198). Presumably, we agree with this statement by experience. The inner aspects of teachers often play a significant role as a personal social capital in expanding their teaching practice. Teachers, who are motivated out of their own convictions, are likely to actively develop their own personal practical knowledge, and to implement particular topics or teaching strategies. Teachers' inner aspects - the most intrinsic part of human being - are naturally and pervasively revealed in their speech, interpretations, utterances, behaviors, etc.

Some studies have attempted to address or articulate the level of a teacher's inner aspects. In science education, for instance, some empirical studies such as Brickhouse (1990), Haney and McArthur (2002), and Friedrichsen and Dana (2005) brought out the

deeper sense of a person, but focused primarily on teachers' beliefs, teaching orientation, or teachers' pedagogical content knowledge, which operate within the theoretical frameworks associated with these concepts. These theoretical-methodological approaches make it difficult to explore and communicate the teachers' deeper moral and ethical values and the way these values and convictions manifest in their teaching. Teachers' inner aspects are so deeply embedded in individual teachers that the even teachers themselves are often unable to articulate them. They are too subtle, subjective and personal, and complex to be classified or reduced by pre-existing fashionable categories. Instead, they should be understood, as a whole, as it exists in a particular person.

One way to articulate teachers' inner aspects and personal experience and knowledge is narrative inquiry, as suggested by Clandinin and Connelly (Clandinin and Connelly, 1994, 2000; Connelly and Clandinin, 1990). They accept that "humans are storytelling organisms who, individually and socially, lead storied lives" and "the study of narrative, therefore, is the study of the ways humans experience the world" (Connelly and Clandinin, 1990, p. 2). By

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having natural communications with participants and looking at the shaping and development over the participants' life histories, researchers can effectively provide insights for what the teachers think, feel, and do, and help the participants themselves to make sense of what they think, feel, and do (Goodson, 1991; Marble, 1997).

In this paper, I adapt another methodology called the "essentialist portraiture", suggested by Witz and his associates (2001; Witz, 2006, 2007). This study, based on the essentialist methodology, especially focuses on articulating personal values, convictions, and concerns of science teachers who have been addressing social, moral, and ethical aspects of science in their classrooms. The essentialist methodology can share the overall methodological aim with narrative approach in terms of absorbing the "realities" of what is going on in a person or social context by constructing a close relationship between a researcher and a participant. However, it more attempts to develop an intuitive holistic understanding of the nature and essence of an individual person by sharing, with sympathy and empathy, the individual's feelings, past experiences, and his or her state of mind. As mentioned earlier, personal values, concerns, philosophies, and convictions are very subjective and complex, and deeply embedded in a person, and therefore, merely listening to (or telling) individual's stories in an objective, biological manner may not be enough to articulate them (Witz, 2007). In this sense, adapting the essentialist approach, which more tries to subjectively get at the essence of the phenomenon in the individual and to evoke the whole image of the person by structuring major aspects of the person, is more suited to achieve the aim of the present study.

II. Purpose of the Study

This paper has two major purposes. One is to introduce the essentialist methodology as a way to articulate teachers' inner aspects at a deeper level, and the other is to present two portraits of science teachers as examples. The science teachers in this paper actively address social, moral, ethical issues regarding science and technology development. These issues include environmental pollution, genetic engi-

neering, the use of animals for experimentation, the energy crisis, and nuclear power plants and they are generally named "Socio-Scientific Issues (SSI)."

The need for inclusion of SSI in science curricula has been generally accepted in the current science education reform, and many researchers and teacher educators has been making considerable efforts to encourage science teachers to implement the reform ideas in their classrooms (American Association for the Advancement of Science, 1989, 1993; National Research Council, 1996). However, science teachers still seem to overwhelmingly follow the "antique" view of science (Davis, 2003; Jenkins, 1992, 2002). Many science teachers feel that teaching scientific concepts, laws and principles, or laboratory skills is their most important task, and any substantive changes - such as addressing SSI and contemporary view of science - would represent a burden (Hansen and Olson, 1996). Regardless of teachers' general rejection of the reform, some science teachers have developed a broader perspective for science teaching and are actively incorporating societal changes or demands within their teaching on the basis of their own deep rooted values and convictions. The subjects of the present study, Jenna and Thomas (pseudonyms), are examples of such teachers. It is expected that deeply exploring these teachers and presenting their detailed pictures will help other science teachers to realize that teachers' inner aspects can play an important role in changing their teaching practices, and will encourage them to reflect on and develop their view of science and teaching.

III. Methodology

1. Essentialist Methodology

1) Epistemological Basis

Subjective aspects of human beings (e.g., feelings, consciousness, worldview, or larger values) have rarely been regarded as objects of study in most social science research. If addressed, these subjective aspects are likely to be categorized and thus are transformed into objective knowledge. However, in understanding the subjective aspects of human beings, the more we try to be subjective, the more we can be objective in some sense. The epistemological basis

for the essentialist methodology is perhaps best articulated by Cooley's (1956 [1909]) principle of "sympathetic introspection," which Cooley describes as

[the investigator] putting himself into intimate contact with [the other] and allowing [him/her/it] to awaken in himself a life similar to [his/her/its] own, which he afterwards, to the best of his ability, recalls and describes. In this way he is more or less able to understand - always by introspection - children, idiots, criminals, rich and poor, conservative and radical - any phase of human nature not wholly alien to his own (Cooley, 1956 [1909], p. 7).

This passage emphasizes constructing an organic link at a human level between participants and a researcher. When the researcher and participants work together with sympathy and empathy, the researcher can help the participants to bring their deeper aspects to the surface, and they, in turn, can help the researcher's understanding. Namely, by being subjectively connected with the participants, the researcher could gain an idea of what kind of persons they are, what their personal values and concerns are, and how they found a fulfillment in their teaching, and so on. On the basis of Cooley's idea, the essentialists attempt to get an intuitive holistic, subjective understanding of the nature and essence of an individual person.

[The essentialist methodology] is distinguished by the fact that the investigator attempts to develop a personal subjective understanding of the phenomenon of interest in different individuals by way of sustained attempts to share, empathetically and sympathetically, the individual's feeling, state of mind and past experience, both during the interview and in many re-hearings of the tapes afterwards... The investigator attempts to get at the essence of the phenomenon in the individual, as that phenomenon is subjectively felt by the individual, by feeling that same essence intuitively in himself or herself, ... (Witz et al., 2001, p. 197-198)

The essence of a particular case contains some of the complexity, depth, and richness of the case, and is dominantly and pervasively represented in the phenomena of the case. The most natural way to understand the subtle and complex aspects is for the researcher to work with the "participant as an ally"

(Witz, 2006).

2) Subjective Understanding of the Participant

Witz (2006) differentiated "interviewing for feeling, consciousness, overall state" from "interviewing for information" and suggested to try "interviewing for feeling" in order to achieve an holistic idea of a person.

In interviewing for feeling, consciousness, or subjective state, I [a researcher] would try to avoid such stereotypic categories and to subjectively understand, as well as I was able, the participant's attitudes, values, and whole experience. In addition, I would try to encourage the student to express herself or himself naturally and freely so that these things could be seen as parts of larger aspects of the student as a person. To develop this kind of understanding would require as much or more objective information than if I interviewed only for information. But the focus would be on the feeling, the subjective state. (Witz, 2006, p. 248)

When the participants talk about their past experiences, the researcher tries to listen to how they now interpret the experiences, how they felt when the experience occurred, whether there are still some resonances—"what the participant is talking about here seems to be related in her mind and feeling to what she was saying over there," "the tone or spirit in which he talks here is similar to the tone or spirit there," and so forth (Witz, 2006, p. 250). This is the most natural, genuine way of human communication.

3) Communicating With Readers by Portraiture

Portraiture tries to get to the essence of the case. It was first introduced by Lawrence-Lightfoot (1997). In her book "The art and science of portraiture", she says that portraiture is "a method of qualitative research that blurs the boundaries of aesthetics and empiricism in an effort to capture the complexity, dynamics, and subtlety of human experience and organizational life" (p.xv). Witz and his associates further develop her idea of portraiture and mention that the individual portrait is "the basic unit of understanding in the investigator and also the basic unit in communicating this understanding to the reader" (Witz, 2006, p. 258). The most distinctive feature of this essentialist methodology is becoming

aware of things in a person and articulating by evoking the image of the person as a whole. Each portrait identifies several essential aspects, and then the researcher articulates these essential aspects in a structured configuration. It presents the essential aspects by logical or temporal means, or by other meaningful structures with the different aspects in proper proportion.

2. Data Collection

1) Participants

The examples of portraits are a part of the author's dissertation study and its pilot study. The author selected two teachers for this paper (see Table 1) because among the participants, Jenna (in the pilot study) and Thomas (in the dissertation study) are very clear examples that can help readers not only to experience the new methodological approach but also to understand what teachers' deep-rooted values and convictions imply and how these can play a larger role in their teaching practice. Also, in order to effectively introduce what portraits are, the author decided to spend sufficient pages for a each portrait within the page limitation of this paper.

Jenna was recruited through personal contact. The author and Jenna had worked together in a teacher interest group (in Korea) which targeted the development of teaching materials on SSI that could help science teachers to incorporate these issues into their

classes. Jenna was a leader of the group and a teacher who most actively developed teaching materials and addressed the issues among the members of the group. Thomas was one of the four participants in the dissertation study (Lee, 2006). The major criteria for selecting participants for the dissertation study were that they (a) were teaching SSI because of their own personal initiative, (b) had (or at least were in the process of developing) a larger perspective on science, SSI, and society, and (c) had a feeling that they were, to some extent, successful in their efforts.

2) In-depth interviews

The primary data source was in-depth interviews with individual teachers (three times for Jenna, and six times for Thomas). The interviews were conducted on the basis of the principle of the "participant as ally" (Witz, 2006). Each interview was about 40 – 90 minutes long. Only three interviews were conducted with Jenna because the first author has known her while working in the same interest group over a period of several years.

The interviewing was sequential so that each later interview explored incrementally one or more specific hypotheses based on what emerged in the preceding interviews (Witz, 2006). A semi-structured interview protocol was used, but the interviews basically followed an informal conversation format. The interview questions included how they became interested in the

Table 1
Demographics of the participants.

	Jenna	Thomas
Nationality	Korean	American (Caucasian)
Age/Gender	Early 40s/Female	Late 30s/Male
Majors	Earth Science Education (BA) Environmental Education (M.Ed)	Wildlife Management (BS) Environmental Law (MA in progress)
Yrs. of teaching experience	17 years	5 years
Current teaching school	K High School (Seoul, Korea)	W High school (Suburb, IL)
Teaching subjects	General Science Life and Science	AP-Environmental Science Biology / Earth Science
Examples of teaching SSI	Nuclear power plants / Land reclamation / Genetic engineering (cloning, GMOs) /Environmental issues /Energy issues	A wide range of environmental issues (e.g. pollution, urban sprawl, non-native species, deforestation, etc.)
Others	Leader of a teacher interest group Member of Alternative Energy Center and the Korean Federation for the Environmental Movement	Former forester Member of farmland protection Leading environmental clubs for students

issues, what personal concerns they had with these issues, how they incorporated the issues into their science classes, how they developed their personal inspirations, values, and teaching approaches to SSI over time, and so on. Some of the interview questions were stimulated by classroom observations. All the interviews were audio-taped and transcribed.

3. Data Analysis

Analyzing the data started from grasping numerous impressions and indications from the interviews. While transcribing and repeatedly listening to the voices of the participants, the author concentrated on forming a picture of each participant in their minds. When the participants talked about science subject matter, their previous or current teaching experiences, or their concerns for students, the author tried to catch the pervasive feeling behind their mode of talking, taking notice of any unusual expressions, intonations, or nuances, or listening to resonances. In addition, I identified their several essential aspects, and then articulated these essential aspects in some kind of structured configuration in proper proportion.

A portrait is often constructed in a chronological manner, like life history approach or biographical studies, in order to effectively present the major strands and their unfolding over the years within a whole picture of a person. In the portrait, major "alive" passages with commentaries are included. Witz (2006) suggested that "the alive passages and subjective aspects which one has identified (augmented by distinctive expressions, resonances etc.) become one's initial isolated islands of subjective understanding, the initial indications of what the forces and sources in the subjective experience, consciousness, world of the participant might be like." Making a timeline helped this process (see Fig. 1 and 2). The author located "alive" passages on the timeline. This allowed the author to see the inner coherence in a person and identify major strands in his or her evolution. For instance, readers can see two major strands in both Fig. 1 and 2, which relates to their motivation for teaching SSI. Each strand may develop or deteriorate over time based on participants' personal experiences, awakening, growth, etc. Or, different strands can merge at a certain period of

time and start enormously developing as a major force (for teaching SSI in this paper) in their lives. From this process, one may be able to get "an idea and a feeling of how all this might fit into some kind of larger picture of the participant's experience" (p. 252). For easy reference, excerpts that were obtained from the interviews were numbered [1], [2],.... At the end of each excerpt, numbers of the interview tape and excerpt within the tape were inserted such as (1:5), which indicated the 5th exchange of the first interview.

In order to establish credibility of the study, I conducted member checking with the two participants after the draft of each portrait was written (Lincoln & Guba, 1985) and made corrections based on their comments (but the participants mostly agreed with the interpretation). In addition, throughout the research process, I exchanged several e-mails to confirm my understanding of each interview.

IV. Portraits

Portraits of two science teachers, Jenna and Thomas, are presented here. The portraits are supposed to address, first, what are their philosophies, deeper motivations, and formative experiences that led them to address SSI, and second, how they have developed their personal inspirations and values relating to SSI over time.

1. Jenna

Jenna's story has two dominant aspects. One is her fundamental experience of her inner self. As a teenage girl, she accepted traditional values without any doubt, but in college, she experienced some of the political and social turmoil and soul-searching that were sweeping the country at that time and which made her become a much deeper person. The other aspect is her constant endeavor to keep integrity between her conscience and actions. The following portrait aims to show how these aspects are also the basis of her teaching SSI.

1) From a monotone world to a larger society embracing self

Jenna's experience of her childhood world reminds

me of a mild monotone painting. In this painting, there is no place for strong distinctive colors – everything is spread with a monotone, which gives a stable, homogeneous, and protected impression – she described her childhood from her present point of view as “a limited space surrounded by walls.”

[1] Study hard and go to a good college. And succeed in my career and serve our society. Like you should be a good person doing a lot of good things. Good things mean that you donate money or something, provide service for other people, that sort of thing. I had never thought about something like structural problems in our society, and so on. As you know, education in school at that time did not teach critical view or this kind of ability very much. (3:2)

“Study hard, go to a good college...” She feels that almost all teenagers were the same: “We all were living in a situation under the same slogan” (3:5). In fact, many people from that generation, when they look back on their childhood, have a similar feeling. It was the time right after enormous national economic expansion and improved living standards. Naturally, like everybody else, she accepted and followed the given maxims. This was the way for her to live in the right way and to be a good person. This does not mean that the problematic aspects of society were not of interest to her; rather, she could not see them in her homogeneous world. When I commented on her explanation – “you didn’t look at stuff like society before,” she corrected me – “I couldn’t see it, not that I didn’t see it.” (3:3). At the end of [1], she strongly appealed to me and justified how she had acquired this orientation.

Her monotone world, however, ended in college. She majored in Earth Science Education. Around the time she went to college (in 1984), many students had a shared notion of democracy, were against autocracy, argued with each other about different political agendas, and clashed with the government to reach their ideals. Like most other students, she joined a reading club and started to study philosophy (mostly Marxism) and Korean modern history with the club members. This literature was totally unfamiliar to her – “I [she] couldn’t learn this in high school.”

[2] [Q: You didn’t know these kinds of things (Marxism,

struggle for true democracy) in high school, right?] Never! I’d never known about it. It seemed like I was in a totally different world. I was surprised when I met friends in the club. I thought the only thing they knew was to study hard, like me, but it wasn’t. They’d already seriously considered their identity, at least, or what life is, or what’s right or wrong... Yeah, they might not know much about our society, but they had done this from their high school years. (2:9)

Her tone in the passage is somewhat regretful, as if she asked herself, “Why didn’t (or couldn’t) I? I thought other students only studied, like me.” Certain incidents made a huge impression on her. She told me a story about her freshman year. Students in her college elected their student president by themselves for the first time and had a large group meeting. In the middle of the meeting, police suddenly came running in and handcuffed the president, and their meeting was dismissed: “It totally didn’t make sense at all! We were pissed off.” (2:6) She was shocked and had a hard time accepting the incident. She had learned what democracy was in high school social studies class and was completely unprepared for what she was experiencing.

Before that, nothing had been problematic in her monotone world. Now there were events that made no sense at all. In her first two years of college, she was hanging in a cloud full of incessant conflicts and experiences. Reactions and feelings appeared spontaneously, but they were not yet articulated well enough to set her own stance. “Shocked” just continued as “shocked.” The experiences confirmed her Marxist readings, but gradually she became more aware of her own real feelings and capable of better articulating them in words. I asked her why she studied these illegal books, and she mentioned peer influence. Then she talked about why this literature meant something to her personally.

[3] ...Something improper exists in our society explicitly or implicitly, but the main-stream people are afraid of disclosing it and try to bury it, right? So, college students – that’s a kind of a particular class of people – we tried to disclose it and read those books, because it existed. That kind of reading (participatory, socially critical literature) and discussion was part of an educational program that the juniors and seniors (in the club) suggested.

But, the reason I agreed to do it was that ... I felt that I needed to know what is wrong, whether what I saw was right or wrong; and if it is wrong, what is wrong... Because I felt that wrongs existed in our society. (3:10)

She had her own reasons to accept the new literature; she was not just following the program given to her by others. She felt she "needed to know what is wrong," regardless of whether Marx or politicians declared that "what I saw was right or wrong". Moreover, she needed to know "if it is wrong, what is wrong... Because I felt that wrongs existed in our society". I asked her why she was interested in that, or wanted to look into that.

[4] ...[Before college] I had thought this [viz. to study hard, go to a good college, be a good person, to serve others, etc.] was the "right" thing, and this is the "only thing that is right." It's more like... I didn't even know there was another right way beside this. I thought it didn't even exist. But there was! I started to think that when you say, "you should study hard" "you should be diligent" and so on, how these things can be fictitious. What are they for? I think I got to realize the problems as I was facing the new world - I should have a certain goal, it should be clearer. (Long pause) (3:12)

Someone may say that it was the time when students generally became aware of the ills of society comparable to in the 1960s in the U.S., so it is not surprising that Jenna became involved in these kinds of ideas. However, in Jenna's case, these experiences not only continuously gripped her heart, they also made her look into herself. After the pause in [4], she said that she did not really know why she was interested in these ideas. Within a year and a half of the other students leaving the club, she stayed in. I asked her why.

[5] I felt "Ah, this needs to be done. Somebody should do this." "This way can be also right" - that kind of feeling? I was indoctrinated by "live right" from childhood in an average family. "You should be nice, you should do something good, you should behave right" and so on. But at that time, my values were not there. It was a kind of "value-free" rightness. I was educated like that. But after I went to college, I started to realize that "Ah... this can also be right" (3:14)

In her monotone childhood, she took for granted that it was "right" to be good and study hard. She was "indoctrinated" to "be nice...do something good behave right...", but at that time there was no real commitment: "My values were not there. It was a kind of "value-free" rightness." By her second or third year, she was getting some perspective. She started to feel deep inside of herself: "Ah...this needs to be done.... This way can also be right." She did not abandon her previous values. There was a deep inner movement, extremely personal, genuine, and fundamental. I call it her "inner pulse." She started to feel "I should have a certain goal, more clearly", and "...This needs to be done. Somebody should do this." She became a much deeper, stronger person who not only upheld the "be good" which she was taught, but who also was determined to help right the wrongs in society. In her junior and senior years, she helped her friends to understand literature and to discuss it in seminars, and she participated in protest movements.

When she graduated from college (February 1988), there was a general expectation that anyone graduating from a college of education at any national university would immediately become a teacher, without taking any exams. Jenna also expected to be a teacher and so was assigned a teaching position for the fall after she graduated. She struggled with whether she should become a teacher or not because her major concern was helping to better society, not teaching. However, she really had no other options, so she started to teach in the fall semester.

2) First years of Jenna's science teaching

In the months before she started teaching, Jenna did not think much about the fact that she would be teaching science. Actually, she had little intrinsic motivation for science. When I asked her: "What did science mean to you when you chose your major in high school?" she said, "Nothing! To me, earth science was a just complex and strange thing." (3:33) Similarly, she had no real motivation for teaching. Then, how did she react to standing in front of a middle school class and teaching the students science?

[6] [Before becoming a teacher] I'd seriously struggled

with whether I would be in teaching or not. [But] What I seriously wrestled with after being a teacher was, “I should love my students, and I want to give something to the students...” But I’d never thought that I could do something for my students through science. As a science teacher, what I could do in my classes... I could tell something that I thought was right, like humanism or whatever through my science classes. While doing that, I started to think how I could teach science well. Actually, in the beginning, I was mostly thinking about how to make science class more interesting. (3:32)

She did not think of connecting her college concerns (i.e. sacrificing herself for a better democracy) to science or even to her teaching. However, while facing her students every day, a completely new feeling and motivation suddenly emerged from her: “I should love my students; I want to give something to students.” (See Figure 1, which shows this new motivation emerging as a strand). However, she “never” thought that she could love or give them something “through science.” Rather, she looked for what she could do for her students that she felt was valuable. One thing that she felt was important was to occasionally talk with them about what was “right” to do. The other thing was she felt a need to teach science in a more interesting way, to help students understand the principles easily, and so on.

After four or five years of teaching, Jenna started to feel that what she was doing was “not enough. I need something different.” (3:36) Around that time (1993), a young woman who had just earned a Ph.D., Dr. Chung, joined the faculty of the middle school and suggested to Jenna to implement STS materials in her classrooms. At first, the STS materials only stimulated Jenna and opened her eyes to a possible realm of science teaching. During the third interview, I asked her to remember any sample teaching topic from that time, and she brought up “El Nino.” She introduced El Nino to her class while she was teaching a unit on ocean currents. I felt that simply addressing STS issues did not necessarily mean that she was concerned about the moral and ethical aspects of science, and so I commented: “That’s not really an issue with a moral element, right?” She said:

[7] (a) You’re right. It might not directly relate to moral things. But it was refreshing because El Nino or other

climate disasters – that kind of topic was not in the textbook. But I intentionally put those issues into my curriculum in order to connect science with the social issues that happen in our everyday life. (b) And, [if you think] more broadly, [you can see that] the El Nino issue originated from people’s over-consumption and over-development. That brings these kinds of disasters...It may be related [to moral aspects]. (c) But anyway, what I focused on was teaching real life issues in science classes, out of the textbook; and second, some meaningful implications that environmental issues involve... You know, we taught a nationalized science curriculum. [At that time] It was common that teachers only taught the contents of the textbook. But I brought in some real life issues, some social issues into my classroom. I think that carried some important meanings. (3:39)

From her point of view today, the El Nino issue is more connected to the moral aspects (that shows in (b)), but she was sensitive to my point, “You’re right. It might not directly relate to moral things,” and immediately explained why she was using El Nino issues then in (a) – “It was refreshing.” She felt that addressing a real life issue that was not in the science textbook was completely new – in (c), she came back to (a) and elaborated it. Obviously, she did not feel that science was directly related to moral or ethical values while she was addressing the issues at that time. Jenna taught for several more years with the general motivation represented by [7], but as she was collecting materials outside of her textbooks she started to notice – partly subconsciously – that quite a few issues that she found involved values.

3) Merged into a fulfillment for SSI

The realization that “science involves ethical and moral aspects” came in the context of working in a teacher interest group organized in 1998. In the beginning, the interest of the group was limited to how to teach science within this context and how to make a connection between science and everyday life, that is, the ideals of the STS movement. As some controversial issues such as GMO and human cloning were hotly debated in the media among different cohorts of people, the members targeted such issues. It was while leading this group and working through such issues that Jenna gradually became aware of the moral and ethical aspects that

science brought in. Today, her point of view is summarized as follows:

[8] I want students to know science is not a perfect key [which can solve all problems]. Science is just one of the products that humans have made. So, it has limitations, it brings problems... You can see how many serious problems science causes. I think science has to have its own clear position where to go. (2:24)

Note her clear tone. Science is a human product, and so cannot be separated from ethical and moral concerns. However, she goes quite a bit further than the mere statement that science generates SSI, which involve ethical and moral concerns. "I think science has to have its own clear position where to go." In other words, science itself should proceed in an appropriate direction with a clear goal and values for society and human beings. Not many teachers would say that science itself needs to take responsibility. She is formulating a perspective on science which has become integrated with her larger concerns. Her stance in [8] seems to be based on connecting

science with her larger concerns for society – what is the right direction for science to take for the larger good of society and human beings. This view is also integrated with her larger concern for students (see Fig. 1). She wants students, as future citizens, to be aware of the new face of science and to be truly responsible in the technological society.

When I met Jenna for the third interview, I could feel that her major concerns had been evolving and widening over time. She was volunteering to teach alternative energy to elementary students at the Alternative Energy Center (AEC) during the summer. The AEC was founded by citizens who were concerned with the devastation of the environment by fossil fuels and the potential danger of nuclear power.

[9] In the beginning [of my teaching], democracy was the most important theme for me to talk about. But now, the overall outer shape may be democracy, but... this has evolved in different shapes over time. For example, what I thought in the beginning was "democracy is the main principle," but now, I am more concerned with environmental issues. Or several issues that democracy can't solve also

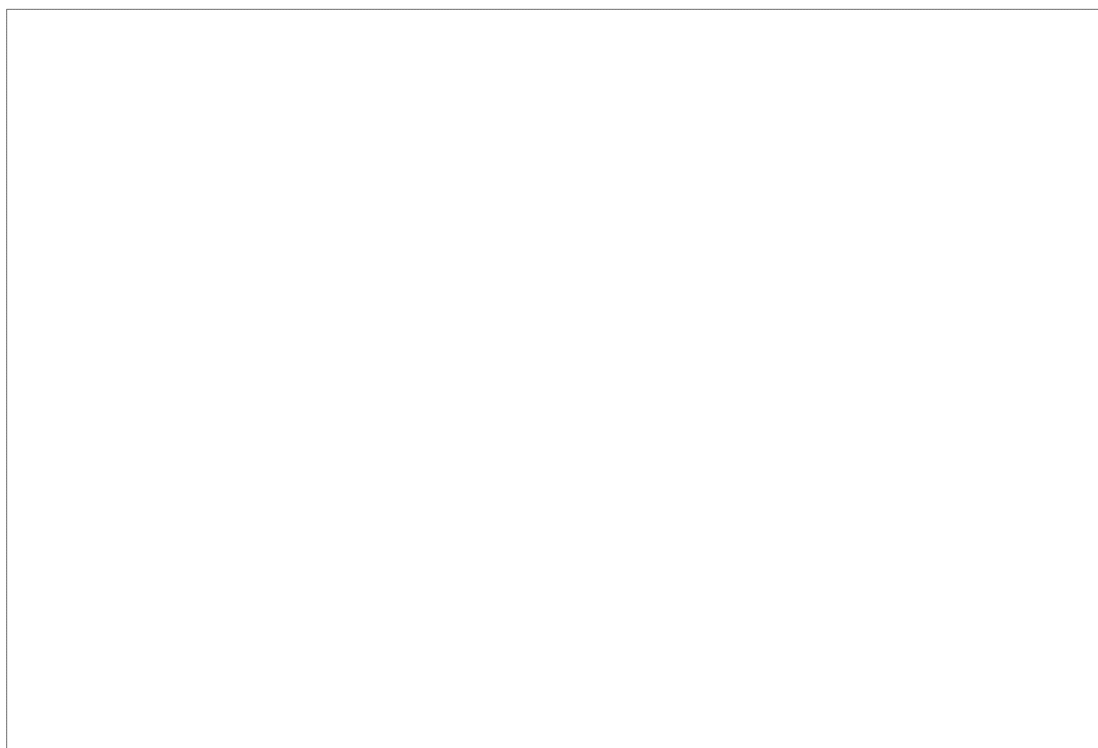


Fig. 1 Jenna's evolution.

can be my priority. The reason I am involved in the Alternative Energy Center is I am concerned with energy education and I believe this is an issue that I should pursue now. (3:29)

Here, she gives a summary of the evolution of her major concerns. She seems to feel that democracy itself is not enough. She is concerned with a much larger issue: “What I focused on in the beginning was democracy, but now it seems more about what is the right way. For example, what is better for humans?” (3:31) This includes a moral, even spiritual overtone. Furthermore, she is acting toward that ideal. Addressing SSI in the science classroom has become more personally meaningful and important to Jenna because all her larger concerns and values are merged together.

2. Thomas

Thomas’s portrait mainly focuses on his deeper motivation for taking care of nature, and teaching and its development. These are illustrated by two major aspects. One is his experience with nature in his childhood, which became the initial basis of his unfolding. The other is his gradual self-actualization in his practice based on his deep-rooted values. His values and faith guided him in a clear direction and they became crystallized in due course in action. Teaching environmental issues, for him, is a part of this larger process of preserving nature.

1) Early experience with nature

Thomas beautifully evoked his childhood memories throughout the interviews and gave a full image of his childhood. He grew up in a large family. When he was young, his parents often took the children outdoors for fishing, hunting, and hiking and created an atmosphere where he could easily be exposed to nature: “[My father was helpful in] getting me interested in...just getting used to it.” (4:6). His memories are full of beautiful feelings from back then.

[10] When I was a little kid—not a little kid—I was about 10-years-old and my older brother and I went off bike riding, went out to — this is when we were living in Wisconsin —, we went off on this bike ride and we

parked our bikes and we went backpacking up into the woods. And we went exploring, you know? And I was sure some people had been back there before, but we went exploring and we followed this little creek—this little tiny creek that was flowing—all the way back to where it started and the water bubbled out of the ground. I remember that as a little kid, I thought, “Wow! This is really neat,” you know, to actually explore. So, that was something that really stuck in my mind as a little kid—actually discovering some piece of nature and knowing that not that many people knew about that. (2:10)

He takes his time to effectively develop the story. In addition, he gives an extremely clear, definite picture of what he experienced. On the way to following the creek all the way back to where the it started, suddenly he found the creek bubbling out of the ground, totally unexpectedly—a moment full of mystery and excitement for him. It was an experience of beauty, freshness, and the glory of nature. The overall tone of the excerpt [10] says that it was not just a temporary excitement for him. Rather, his whole being—his mind, soul, and body—was touched by the splendor and surprise of the mystery.

Thomas’ experience was somehow extended to fostering his intrinsic moral nature. When I asked him: “When did you start to think about the moral or social aspects regarding the environment?” he brought up the story of watching a two-minute long commercial produced by Keep America Beautiful, Inc. A Native American was paddling his canoe in beautiful scenery. Then all of a sudden, the camera view came up and started zooming in on pollution and the skyline. The climax scene was this: “He (the Native American) looks down and he sees the litter—garbage all over. And then he looks up and they show a tear com[ing] down [his face].” (1:22). Presumably, not many children are affected as much as he was by watching a two-minute TV announcement, but he could remember the story in detail as well as its message. Why was he so affected?

[11] I think why it affected me so much was the fact that I think part of it was the individual in the picture. Here’s this man [and] this is what he had, this was his. And in the sense, we took it away from him, destroyed it. In the video, it’s basically saying we’re the ones who did that to him. I think what affected me was the

fact that it was in a sense—the message was that I'm responsible. I'm the responsible one, even though here I am sitting watching the TV. All this pollution and litter and everything, everybody adds to it. And I think that that's really what it was. It wasn't so much the issue of like the nature or something. It was the fact that I'm responsible for that. (6:10)

He, as a moral being, intuitively understood the meaning of the tears and felt sorry. In saying, "We're the ones who did that to him," [11] he reveals that there is an embryonic, intrinsic moral element within him — a seed at the level of the soul. The seed is buried in deep ground and is not visible until he goes to college.

2) Gradual growth of Thomas' care for the environment

Thomas's sisters and brothers used to call him "Nature Boy" (4:35) because even though they all had similar experiences with nature, Thomas was much more affected than they were. The basis of his unfolding was like a reservoir of all different kinds and depths of feelings regarding his experience with nature.

During his high school years, Thomas had different kinds of interests and thoughts, just like other teenagers, such as about mechanics, sports, etc. He was not very interested in actively helping the environment or being involved in activities for preserving it: "In my teenage years, I wasn't that much focused on it. I wasn't going out and doing things to help the environment or anything. I really wasn't." (4:17). However, he gave himself time to carefully look within and to figure out what he really wanted to do. The line of his thoughts finally led him to nature.

[12] [Q: What was your state of mind at the time so that you specifically chose wildlife management as your college major?] To me, that was what I thought would have been the most interesting and it sounded to me like the job opportunities would be the most enjoyable. That's what I think it was. And, I thought that if I go in that direction, at least it was something I wanted to learn about. I didn't know for sure at that point [that I was] going to do that for the rest of my life. But I just thought, "This is something I definitely want to learn about." That's why I did that. (2:19)

He did not seem to know what exactly wildlife management was, but intuitively he knew he would enjoy it. In fact, from then on, he did not hesitate to choose his college major: "When I chose my major, I stayed with it right through. I never changed anything" (1:17).

When Thomas entered college as a freshman, the seed started to grow almost immediately. His experience in the coursework helped him to substantiate what he felt. While taking classes, he was becoming more confident about his direction: "I wanted to do that type of thing." (4:23). Another stimulus was his experience in reading Aldo Leopold's book entitled *A Sand County Almanac* (1949), which he also selected for his students in the AP Environmental Science class. He still clearly remembers what his feeling was when he first read the book.

[13] [Q: In the last interview, you told me about your feeling when you first read the book—like, "This is right." That means you already had some kind of feelings or thoughts about nature at that time.] Yeah, and then what I think true is also the fact that—particularly about Leopold's book—, like I said, "This is right, but I never thought that before." You see? I never sat there and would think about... People would think that food comes from the grocery store and heat comes from a furnace, you know? And when I was a kid or something, I never would sit there and think about something like that. But, when I was reading it, "Ah-ha! That is right!" but I never thought of it on my own. So, that's, that's what I thought. [The] key is that he'd like to draw stuff out of your mind with some of the stuff that he had said. But, yeah, nobody had taught me that really before. But, once I'd think, "Yeah. Yeah, that is right." (4:21)

His basic reaction ("Ah-ha! That is right!") was spoken in a very confirming tone. Leopold pulled out of his mind what he had felt but could not articulate in words. This reaction proves that he instinctively understood what the author meant. Also, it reveals his excitement coming out of the experience that someone exactly brought to the surface what existed in his state of mind in a clear manner. It was apparently inspirational enough for him to look within himself, reflect on his values, and envision the real issues facing the environment.

This awakening was connected to his small en-

vironmental activities. At the end of the first year, he felt: "I'm going to try that (actual involvement)" (4:22) because he knew that "Like you see it in a lesson, you see a diagram, the teacher teaches about, or maybe you go on a field trip, but that's not the same as doing it." (4:18) He was aware of the urge inside of him and this urge immediately connected with action. His first job was as a student forester at a county forest preserve during the summer after his first year of college.

[14] I saw all this beautiful forested land—these beautiful trees—and all of a sudden, all these weedy little trees growing everywhere, growing everywhere. And the plant, then I found out, was called "buckthorn" and it's not from this country. It came in as an alien species but now it's taking over our forests around this area. And I talked to my supervisor, I said, "What's going on with stuff? Is anybody doing anything?" And he said, "Mmm, not really." And I thought, "Well, we got to get going on this. Somebody needs to do it." And I found out that there was a group that was helping to cut this stuff down and restore and now it's much more popular—people are trying to get rid of that stuff. So that was one of my early things around this area that caught my attention. In my early professional career I saw something like that

and I said, "We've got to fix this!" You know? [Laughs] So that was probably one of my earliest motivations. That was way back, just my first year of college. That was the first real issue that I caught on to. (1:39)

His sudden awareness of the reality contained a strong moral and ethical motive, enough to initiate his feeling of duty to restore the forests: "Somebody needs to do it." "We've got to fix this!" (1:39). A small awakening brought small actions, and the small actions were followed by more serious involvement. His values and ideals, latent since childhood, came gradually to the surface and were actualized.

3) Thomas' religious beliefs

Thomas has never had any questions about his path since he decided his major in the environment-related field. He was quite aware of what he likes, what he really wants to do and needs to do in this field. I was curious about the source of his strong motivation for preserving the environment. One major thing that Thomas brought up was his religious faith, and he told a story of his profound religious experience. When he was a senior in high school, he was a football player. One day, he had a serious

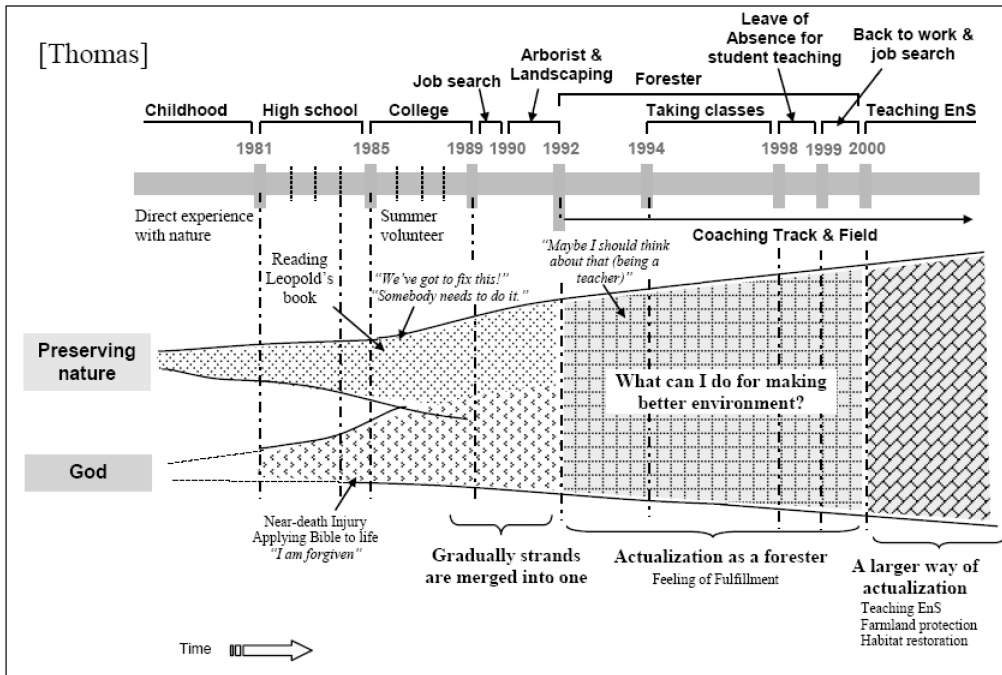


Fig. 2 Thomas's evolution.

accident by colliding with another player and almost went into a coma. He remembered that having the brain injury and overpowering pain were very fearful. So, he desperately prayed for his recovery and God responded to him. He felt "tremendously grateful,... (and) a tremendous relief." He also thought that "because the belief that I am forgiven,... God's forgiven me, that now I am thankful to help out and do things." (5:2).

[15] I think that's a good motivator, a feeling that I'm grateful for the blessings that I have. And then, how that translates to the environment, um, [pause], I think that that translates, goes in the direction of the environment, because that's [where] I saw my focus of work. And so, then I'm in a sense putting my effort and my gratefulness, that attitude, toward that aspect of the work, you know? And I think that's what it was, is just that I [want to] do the best job because of that. It wasn't necessarily that I think it was just the fact that I had chosen the environment as my calling. And if I had chosen something else, I would've worked hard at that too. Do you see? (6:22)

The thing that he could help out was, he believed, to preserve the environment. As Fig. 2 shows, his care for the environment was integrated with his religious belief around this time and later on they become a strong motivation for preserving the environment.

4) Actualizing his concerns by teaching science

Thomas exemplifies that deeply embedded values in a person can be synchronized with one's larger direction in life. Throughout his life, he has gradually moved in a direction that was motivated by his deep feelings. For instance, after graduating from college, he looked for a wildlife-related job. After working as an arborist for a year (because he could not find another job right after graduation), he found a job in a county forest preserve doing habitat restoration work, such as planting or replanting trees, preserving certain species, and removing weeds or non-native species. He held this position for about eight years.

During the first three or four years as a forester, he concentrated on his work: "During that time I wasn't even thinking of it (becoming a teacher). I had my

career and everything." (1:2). He was fulfilled then. However, he did not stop there.

[16] When I was working out in the woods, you're out there and you're working and you accomplish work. But then, you're thinking to yourself, "Now, if I'm doing this for the next 20 years," maybe you'd fix this area and fix this area, but how much of a total impact is there? And I thought about that and I thought, what do I want to accomplish? And one of the things I think is really neat with students is you really influence students to help and get them interested in the environment and caring about the environment, especially just generally the world around them. And some of them you can catch and then actually get them more interested. ... that's what I think is really, really effective—is the fact that you really do affect the students, and get them. (1:14)

As [16] shows, he kept searching larger ways to preserve the nature and concluded that he could do more as a teacher rather than as a forester. However, he was not in a hurry to make a career change. After deep contemplation, he started to take college classes in education, and finally got a position at a high school teaching Environmental Science, Earth Science, and Biology. Thomas now feels fulfillment in his teaching by getting students involved in helping out with nature. He also tastes a piece of the delicacy of teaching.

[17] [Q: I felt that for you teaching about environmental issues is a larger way of actualizing your ideals.] That's true. That is true, yeah. So, that's why. And you're right. A lot of people will become teachers just because they love school. You know, they love to be in school. They [want to] be like... You're right. That's not why I'm here. It's part of helping out. You're right. To get the kids interested and teach them. (6:5)

Teaching is a larger way to help out the environment. Out of his personal concerns and values, he deals with various environmental issues. In addition, he actualizes his ideals by doing other environment-related work outside school. He is involved in protecting farmland from developers and malls that are built without any particular larger plan by starting a group that meets monthly to protest urban sprawl. And each spring and summer, he still volunteers to

do restoration work. In addition, he is planning to go to graduate school to study Environmental Law, concentrating on all the administrative levels. This is Thomas—always improving himself, always moving forward to achieve his ideals.

V. Discussion

The aim of this paper was to introduce a way of articulating very subtle and deeply-rooted inner aspects of teachers, without using theoretical formulations or categorizations, and to present its examples. Two portraits tried to articulate two science teachers' personal values, philosophies and convictions in relation to teaching SSI in their science classrooms. Compared to other narrative studies, the essentialist methodology attempted to evoke the image of each participant in a subjective tone by using relatively long alive passages. Moreover, the portraits, like biographical studies, often presented the development of each person in terms of their values, philosophies, experiences, or personal theories, but they tend to be organized based on the major strands of the person, which are pervasively represented in a person (see Fig. 2, 3). The essentialists believe that this ways of organization would help readers to feel the depth, complexity, and subtleness of the inner aspects of a person. When reading the portraits, therefore, it is also important for readers to prepare themselves to depict the images of the participants in their minds, not to merely pay attention to factual information or events in the portraits.

Thinking about Jenna and Thomas together as a whole, one feels that there is an essential commonality in their inner states. Their inspirations for teaching SSI came from "within," without any contact with external pressures (e.g. curriculum reform). Instead, their energy was fueled by ideals, deeper values, or personal concerns, which involve some higher elements. Higher ideals usually have metaphysical, moral, and spiritual-religious overtones. For instance, Jenna got to know about STS by Dr. Chung and started to introduce STS topics in her classrooms. However, as time went on she herself realized that science had intrinsically ethical and moral aspects, and science teachers should address the aspects. Then, she started

to address SSI, not limited to STS topics, out of her own ideals and conviction. Jenna's higher ideal was to help society to be better, and by teaching SSI she wanted her students to become "responsible citizens" who are seriously concerned about the condition of this contemporary society, and who are able to take action to make a better society, and this became enlarged to humanistic concerns. Thomas' higher ideal was to care for the environment, and he used his teaching to encourage his students to participate in caring for the environment. His higher ideal was also unified with his religious faith. For both teachers, teaching SSI is one way to actualize their higher ideals.

Another commonality is that their values and inspirations unfolded in each of them throughout their lifetimes. The portraits present well their shaping and development. In their childhood or adolescence periods, their shaping often existed in seed form, with the potential to develop. However, the seed is intrinsically embedded as a part of their inner state of each person. Over time, it buds and blossoms in the person. In Jenna and Thomas, it developed into higher ideals or visions for a better world. Certain situations or factors may help this process. For instance, Jenna started to open her eyes to social injustice when she was in political situations and participating in student movements and reading clubs. However, what made her fundamentally move was coming out of herself. See [5] — "Ah-, this needs to be done. Somebody should do this." Even though half of the students left the club after about a year, she stayed in it because she felt "this is also a right way to live." Similarly, Thomas was affected by direct experiences of nature in his childhood, reading, and college courses. But the main source of his motivation for taking care of nature also came out of his deeper inside: "We've got to fix this!" (see [14]). Basically, both teachers became aware of what was important in their lives while in the process of self-reflection, and they followed their values. Therefore, both cases show tremendous clarity and integrity.

Someone may ask why we need to pay attention to the subjective aspects of teachers like a person's inner aspect and its unfolding and even to articulate them. One reason is that teachers' deep-rooted values and

convictions often play a significant role as a personal social capital enough to expand their teaching practice (i.e. teaching SSI, STS, or NOS). Teachers, who are motivated out of their own convictions, are likely to actively develop their own personal practical knowledge, and to implement particular topics or teaching strategies. The two portraits of Jenna and Thomas present how personal history and larger ethical concerns can lead teachers to deal with such issues in class on a regular basis. Another reason is that as Witz and his associates (2001) mention the deeper understanding of teachers' inner aspects becomes a basis of deeper understanding of their teaching practices because the inner aspects often affect their way of teaching, selection of topics, way of communicating and so on. The other reason is that it is important for pre- and in-service teachers, who are still in a formative stage, to see examples of teachers who exemplify inner unity and who are successfully addressing SSI based on larger ideals.

From this way of articulation on teachers' inner aspects, we can think of some implications for science teacher education. The two portraits confirm that without synchrony with individual teachers' deeper motivations, we cannot expect these programs to bring about real changes in science education. And, in practice, the deeper motivation typically emerges spontaneously within the teachers at some point in the total situation in their lives. Witz and Lee (in press) suggested:

Ideally, in-service workshops and teacher education programs should be designed so that the teacher's or pre-service teacher's own larger motivations and higher values should motivate her to make changes in her understanding and teaching. The general philosophy for teacher educators should be to become more aware of the nature and special role in teachers' lives of the larger understanding they have of science and of society, and how that plays numerous roles in their lives and teaching.

This passage implies that science teacher educators need to understand the current state of individual science teachers who are facing reforms in science. Some science teachers may have a strict traditional view of science and highly value it and so feel hard to accept the need of addressing the new conditions

of science. Some other science teachers may accept the current view of science, but not be motivated to do it because their values and concerns do not match with it. Regardless of this, science teacher educators often call for science teachers to change their view of science and their teaching practices in order to respond to meet the current need, without much understanding of teachers' inner aspect. In this case, it would be hard to expect real changes in our science classrooms. Instead, teacher educators need to encourage them to develop a larger vision for science and society by reflecting their own personal concerns and values.

References

- American Association for the Advancement of Science. (1989). *Science for all Americans*. Washington, DC: Author.
- American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York: Oxford University Press: Author.
- Brickhouse, N.W. (1990). Teachers' beliefs about the nature of science and their relationship to classroom practice. *Journal of Teacher Education*, 41(3), 53-62.
- Cho, H. and Choi, K. (1998). The necessities and current states of science education dealing with socioscientific characteristics of science. *Journal of the Korean Association for Research in Science Education*, 18(4), 559-570.
- Clandinin, D.J. and Connelly, F.M. (1994). Personal experience methods. In N.K. Denzin and Y.S. Lincoln (eds), *Handbook of qualitative research*, pp. 413-427. London: Sage.
- Clandinin, D.J. and Connelly, F.M. (2000). *Narrative inquiry: Experience and story in qualitative research*. San Francisco: Jossey-Bass Publishers.
- Connelly, F.M., and Clandinin, D.J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, 19(5), 2-14.
- Cooley, C.H. (1956). *The two major works of C. H. Cooley: Social organization and human nature and the social order*. Glencoe, IL: Free Press. (Original work published 1909)
- Davis, K.S. (2003). "Change is hard": What science teachers are telling us about reform and teacher learning of innovative practices. *Science Education*, 87(1), 3-30.

- Friedrichsen, P.M., and Dana, T.M. (2005). Substantive-level theory of highly regarded secondary biology teachers' science teaching orientations. *Journal of Research in Science Teaching*, 42(2), 218-44.
- Goodson, I. (1991). *Biography, identity, and schooling : Episodes in educational research*. London; New York: Falmer Press.
- Haney, J. and McArthur, J. (2002). Four case studies of prospective science teachers' beliefs concerning constructivist teaching practices. *Science Education*, 86(6), 783-802.
- Hansen, K.H. and Olson, J. (1996). How teachers construe curriculum integration: The Science, Technology, Society (STS) movement as Bildung. *Journal of Curriculum Studies*, 28(6), 669-82.
- Jenkins, E.W. (1992). School science education: Toward a reconstruction. *Journal of Curriculum Studies*, 24(3), 229-46.
- Jenkins, E.W. (2002). Linking school science education with action. In W.M. Roth and J. Desautels (eds), *Science education as/for sociopolitical action*, pp.17-34. New York: Peter Lang.
- Lawrence-Lightfoot, S. (1997). A view of the whole. In S. Lawrence-Lightfoot and H. J. Davis (Eds.), *The art and science of portraiture*. San Francisco: Jossey-Bass.
- Lee, H. (2006). *Science teachers teaching socio-scientific issues (SSI): Four case studies*. Unpublished dissertation, University of Illinois at Urbana-Champaign.
- Lincoln, Y. & Guba, E. (1985). *Naturalistic inquiry*. Thousand Oaks, CA: Sage.
- Marble, S. (1997). Narrative visions of schooling. *Teaching and Teacher Education*, 13, 55-64.
- Ministry of Education. (1992). *The 6th Korea National Curriculum Standard*. Seoul:Daehan Printing and Publishing Co.
- Ministry of Education. (1998). *The 7th Korea National Curriculum Standard*. Seoul:Daehan Printing and Publishing Co.
- National Research Council. (NRC, 1996). *National science education standards*. Washington, D.C.; National Academic Press.
- Witz, K.G. (2006). The participant as ally and essentialist portraiture. *Qualitative Inquiry*, 12(2), 246-68.
- Witz, K.G. (2007). "Awakening to" an aspect in the other: On developing insights and concepts in qualitative research. *Qualitative Inquiry*, 13(2), 235-58.
- Witz, K.G. and Lee, H. (in press). Science as an ideal. *Journal of Curriculum Studies*.
- Witz, K.G., Goodwin, D.R., Hart, R.S. and Thomas, H.S. (2001). An essentialist methodology in education-related research using in-depth interviews. *Journal of Curriculum Studies*, 33(2), 195-227.