

Interviews of the Margaret MacVicar Memorial AMITA Oral History Project, MC 356
Massachusetts Institute of Technology, Institute Archives and Special Collections

Elizabeth Cavicchi – class of 1978

Interviewed by Colette Abah, class of 2015

November 3, 2015

Margaret MacVicar Memorial AMITA Oral History Project

Elizabeth Cavicchi (SB, Physics and SB, Humanities and Science, 1978; SMVisS., Environmental Architecture, 1980), was interviewed by MIT undergraduate Colette Abah (SB, Mechanical Engineering, 2015) on November 3, 2015, in a conference room in Building 4 on the MIT campus. Following her years at MIT, Cavicchi earned additional degrees: Boston University, M.A.T., 1986; Harvard Graduate School of Education, Ed.M., 1997 and Ed.D., 1999. Cavicchi was also a Dibner Institute Postdoctoral Fellow from 2001-2003.

ABAH: Good morning, Ms. Cavicchi. Will you tell me a little bit about your childhood-- where you grew up, how you grew up, and the value system that was instilled in you as a young kid?

CAVICCHI: I grew up in a suburb of Cleveland, Ohio. My father was an aeronautical engineer at NASA, where he worked for a total of 61 years--

ABAH: Wow.

CAVICCHI: --65 years of combined federal service, maybe. So this was during the Apollo era. And I have two brothers. My brothers both went to MIT, [Richard E. Cavicchi, SB Physics, 1980; Thomas J. Cavicchi, SB Electrical Engineering, 1982].

ABAH: Oh wow. Congratulations.

CAVICCHI: We were very enthused about the space program. NASA had family nights regularly where children and parents would get to see films-- movies of the astronauts or aeronautical history, old airplanes. It was a very exciting time for science. My parents encouraged all of us in science, in doing science. We felt like being at the inside of the most exciting science adventure ever! The experiments, the calculations, the instruments, the people – we saw these happening first hand. We identified with the rockets and those engineers who were on the ground in support. This gave me respect for and connection to science, and its endless possibilities.

Science for girls – that was not something that the school community or your peers were open to. But I remember in sixth grade I had a teacher who set up a place in the basement of the school, where students could go and make up pulley arrangements on their own. And I remember hooking up 24 (or something like that) pulleys. And so that was-- an exploratory experiment. It was an example where as a child in school, I experienced the curiosity and activity of doing science – in a way that connects with the exploratory education that I now try to encourage with my students and research.

ABAH: So you said your father was at NASA. What did your mother do?

CAVICCHI: My mother was the Director of Christian Education at our church during my childhood years. She was an educator in organizing activities with the young people and in organizing the Sunday school program. She placed great value in kids' – young people's

– thinking and development. The value and commitment that she had for shaping education so that it encourages and centers on the creativity and experience of the child. This connects with the aspirations I have, that my work in education support learners in discovering the world and their minds, and developing in creative and thoughtful experiences.

ABAH: So what motivated your choice to come to MIT?

CAVICCHI: My father was an MIT graduate.

ABAH: Oh, wow.

CAVICCHI: And he graduated in-- He was the class of '44, but there was the war, so he served on the Army Corps of Engineers on the 1717 Floating Power Plant that provided power to the city of Antwerp, to the corps, during the Battle of the Bulge. And he finished at MIT in mechanical engineering in 1947.

And he lived locally, in Woburn [Massachusetts]. I now live in the house that he grew up in, his dad's house. So as summer vacations, we would always come to see my grandfather. We'd come regularly every year, once a year in the summer, to the Boston area. And then have a vacation with my family in New Hampshire.

[In 1948, Richard Cavicchi became an aeronautical engineer at Lewis Research Center, NACA (National Advisory Committee for Aeronautics), where he continued as a researcher until his retirement from NASA in 2009. He wrote more than 50 technical reports and contributed to turbojet cycle analysis, compressor and turbine design, nuclear-powered aircraft and spacecraft, electric power generation, and computer codes for internal fluid mechanics.]

ABAH: So you had a chance to visit the MIT campus quite a few times?

CAVICCHI: Well, actually, no. I only visited MIT before I applied. Probably it was my junior year of high school, when you visit colleges. I visited several schools. There's a picture of me and my brother. I was pretty young, visiting MIT. So I think it must have been this visit. And I had also-- I also eventually applied to Harvard and Cornell. I also visited Vassar, where my mother went to college. And I never visited Cornell at the time. So I feel like if I had seen the campus – it's so beautiful – I would have gone there. But I hadn't seen it.

ABAH: Unfortunately!

CAVICCHI: My father really encouraged me to apply to MIT. He thought a girl could do anything. And I ended up deciding between MIT and Cornell. My grandparents were in the local area. So I thought about that.

But I also knew two boys who were in the high school class ahead of me who went to MIT. And they were very impressed. And I had a sense, I think, from them just free-flowing, kind of creative environment. So that interested me, and so I came here.

I came here intending to do both physics and art or humanities. I think I said this in my application. I ended up doing two majors, physics and an interdisciplinary called Humanities and Science, in course 21, it was called a Major Departure: a self-designed interdisciplinary major, it was not under a particular subdivision of the humanities program.

I stayed at MIT for a master's in visual design, which is called Master of Science in Visual Studies, environmental art.

ABAH: Let's talk about your time as an MIT undergrad. Where did you live?

CAVICCHI: I lived the first three years at East Campus. And within the first hours, I think, of when I arrived at MIT, I met a classmate, Alanna Connors [SB Physics, 1974 (1956-2013)], who, I think-- I must just immediately have become best friends with her for the rest of our lives. And she also lived in East Campus.

We were on the fifth floor, but on opposing wings. So we had to go up and down 10 flights of steps or something to see each other. And we majored in physics. We both spent as much time as possible together.

Being with Alanna was continual inspiration for me. She was whimsical and curious, attuned to wonder and beauty in the world and in the mathematical physics we studied together. Alanna looked for the deep relationships at work in the behaviors of nature. As she sought understanding, she looked for it to interrelate with a coherence that holds under many ways of coming at the question. Unlike many of our classmates, she was not satisfied just to complete whatever some assignment required and close the topic. By her effort to see and understand and think everything in the fullest ways possible, she continued working, calculating, revising, rethinking. Something would be uncertain for her; she would diagram it again in colored pencils, start a new page, describe the problem in some different perspective. Through being her companion as we sat side by side in lectures, did physics lab as partners, and collaborated in assignments, I saw the moment-to-moment integrity and creativity of her questioning and thinking. With her, I experienced what it is to learn with a genuine spirit of investigation.

In my teaching and research now, I aspire for learners and teachers to find their own questions emerge, for them to learn and interact by way of investigative curiosity.

My junior year, the people that had attracted me to the dorm had all graduated. And the character – there was a big influx of new people – changed. And there were a lot of drugs and loud parties, and I didn't feel like I wanted to be there anymore. I didn't spend much time there.

There were four of us women, we were the first women to live in that part of the dorm in my freshman year. One of these was my friend, Julie Keller [SB, Chemical Biology, 1978], who immediately became involved with the process to create the Women's Independent Living Group. She was among the first women's independent living group

residents to occupy the building during her junior year, and I visited her there. And I noticed it and moved to WILG for my senior year of MIT. And I also lived there part of my graduate master's program time.

ABAH: What was your favorite part of your living accommodations, both at EC and at WILG?

CAVICCHI: I think a special quality of living in the dorms is the space. There can always be somebody around. And you don't make arrangements or appointments to see people. They're just there doing stuff. And I feel like that was more lively during my first two years at East Campus. And then I could, at any moment, just walk over and see my friend Alanna, and also even the people in the area of the dorm where I lived for three years.

I enjoyed WILG. It was a beautiful living space. It was quieter. There wasn't the same kind of spontaneous, crazy intensiveness there. And people more stayed to themselves there. So it was a little different. But after the kind of harrowing time my junior year, I was glad.

ABAH: Did your friend Alanna move with you to WILG?

CAVICCHI: She stayed in East Campus. Of course, the makeup of her floor was different. Plus she had a good friend. [LAUGHS]

ABAH: Her boyfriend?

CAVICCHI: Her boyfriend, in Senior House. They stayed together and married! I am grateful for the life of love and community they created together.

After graduation, they went to Maryland, where she did her doctorate in physics and astronomy, working on gamma ray burst stars. Her awareness of details being the indicator of bigger relationships, that I saw in our college work together, was there in her efforts to study and introduce Bayesian statistics into astrophysics. For several years, she did space science research at UNH [University of New Hampshire]; later they returned to Massachusetts, where their son, Roy, was born. He is now in the world with his own ways of investigating, delving deeply into matters and sharing in communities.

ABAH: Wow, that's a great story. What would you say was the most challenging part of being a woman at MIT at the time when you attended?

CAVICCHI: I think that we didn't have access to our peers. Alanna and I were often the only women in physics classes. We worked together on problem sets. And we talked about the material together, without much access to our classmates. I think there were very few occasions where we would work with any of the boys.

We were lab partners for the year-long course of physics junior lab. We were also lab partners in a semester long lab course, called physics project lab, which we took in the second term of our freshman year.

In the physics courses, which were theoretical only, there was the sense that the professor didn't expect you to be there, to be doing these things; [that he] didn't probably include you in the same way as things that were going on as with the boy students – not that we could always see through that.

However, I had a wonderful physics professor, my physics advisor. And he was also the advisor for Alanna. We both had the same advisor. He really was very inspiring for me for my whole life after that, [MIT Institute Professor Emeritus] Philip Morrison. He really had faith in us as students to do-- to read any book, to learn anything, to go on and do any kind of creative work. Where I saw barriers and failure, he saw opportunity and possibility. So that was different from the more stern and intimidating environment that I felt in a lot of academic settings.

My relationship with Phil Morrison really grew more later on. I was his researcher for the six-part public TV series "The Ring of Truth," which he developed and in which he was filmed.

ABAH: That makes sense. You mentioned there was a kind of distance between you girls and the boys. What do you think caused that? Was there an explicit example-- were there explicit incidents? Or was it just the atmosphere?

CAVICCHI: I guess you didn't feel welcome. You didn't feel like people were talking to you. You'd just walk in, and you'd sit together. And there was nothing like social means to bring us together. The whole undertaking was very serious, competitive. I think Alanna had less trouble than me. As I said, I was very shy.

And I had a lot of anxiety. I believe that I had what you would now call-- I don't know what the word is now-- test anxiety? There's probably a word for that now. But now people make accommodations for people that become terrified. I would just totally freeze up on exams. I couldn't-- my mind wasn't accessible to me. And in the MIT environment of the time, I interpreted that I was stupid, and I couldn't do it. And Professor Morrison and other people who knew me didn't believe that. But the environment led me to believe that.

And then not having access to-- again, we [women students] were 15% overall at MIT. But in physics and math, there were very few women. There was an isolating component to it.

The faculty were in a way more open, at least to meet and encourage women students in their studies. Whereas I encountered the environment among the male students as not being open to my participation

ABAH: Did you have any extracurricular involvement?

CAVICCHI: Yes. My friend Alanna was on the sailing team. She was an athlete. I didn't do anything athletic. Although maybe now I think would have benefited from it. But I didn't.

I participated all the time, from the middle of my freshman year on, in the Student Art Association. And a lot of the courses that I was taking – well, one course a term for my humanities degree were actually in architecture, where I was making everything that I could relate to sculpture. And at the time when I was a student, and maybe it's still the case, the only place that I knew about at MIT where you could work on something on your own and have space to construct something creative and artistic was the Student Art Association.

And the only medium that was really available to me was clay, ceramics. I vaguely knew about the MIT Hobby Shop, but I never went there. I would have needed to have more encouragement to find the place and learn to use the woodworking tools. This is something I wish that I had learned to do at that time. And the courses that I was taking trying to learn to be a sculptor, at that time, did not provide studio work materials. So I had to come up with that on my own, which I did through Student Art. Later in my life, I did woodworking with carving. And I would have been interested if the whole range of sculptural materials had been available to me at MIT.

There was an MIT metallurgy lab where I did some metal sculpture. I took two oil painting courses at Mass College of Art [Boston] during my MIT graduate program. There were no formal oil painting courses offered at MIT.

In the year after my MIT masters degree, I enrolled as a student in a glassworking class at Mass College of Art. All the work was done with cold glass; I did not learn to do glassblowing. At the time when I was a student at MIT, the glassblowing lab was not available for students to learn, or at least I didn't know how to participate in the MIT glass lab. But there was not really an environment – at least as I encountered it- through which, as an artist, I might come to try and know about traditional and new materials and practices of visual arts-- it was more-- the classrooms for the sculptural artistic work was hearing lectures and watching slides. You didn't see sculpture or art happening and being made; and then you were supposed to go out and find a place to work. But you didn't have the support that an art school would provide; there was no studio workspace for becoming a sculptor, materials and shops were dispersed. I was not informed about how to access any separate facilities [such as Hobby Shop, or any foundry or metalworking facility that there might have been] and any actual materials.

So. The Student Art Association. I would do the firing. I would do making the ceramic sculpture forms that I was doing-- I would do the whole process there-- hours and hours and hours. And then later, when I did my MIT SMV'S thesis, my husband [Alva Couch, SB Architecture, 1978] worked together with me in the dark room of the student Art Association to develop film and print the images/photographic illustrations for my master's thesis.

Alva was an MIT classmate, graduated in my year, 1978, and we married the following year.

I also participated in the MIT Lutheran Episcopal Ministry. This was more toward my later years as an MIT student and a graduate student that I knew about that group and

went to it. They would meet on Wednesdays after class. They had a meal together, and I could participate in that. And I sometimes played my flute.

ABAH: So it was a kind of fellowship--

CAVICCHI: A fellowship group, yeah. Undergraduate and graduate students.

And then I also did a UROP. I don't know whether that's extracurricular or not. But at the time, I was doing it as a student worker under UROP for the biology department, the biochemistry lab of Alexander Rich [William Thompson Sedgwick Professor of Biophysics; discovered polysomes and Z-DNA].

ABAH: Wow. Was it an application of your physics side or your art side that you were doing biology?

CAVICCHI: Both my interest in art and science were involved in my biology work. I was very interested in biological understanding of molecules, which was just beginning to work out the structure of molecules at that time with a-- not the kind of electronic images, softwares, graphical images that we have today. Didn't exist.

So my first job in the lab was to build, with physical wire models, the entire structure of transfer RNA, which had been discovered and developed by this lab-- x, y, z coordinates make a three-dimensional model. So it's, like, five-and-a-half feet by three-and-a-half-foot, by four feet tall. The MIT Museum now owns the model that I built -- it was selected as one of the 150 artifacts that MIT Museum displayed for the MIT 150 celebration. I did that work on the tRNA model before I took any courses in sculpture. And I felt -- and also the researchers in the lab felt -- that was like a sculptural education for me.

ABAH: Did you make the sculpture out of clay?

CAVICCHI: I made it out of wire, wire model parts that were used in that era. There was a hemoglobin model, made out of the same model parts at the same scale, in the biology department, down the hall from the lab where I worked, which I don't think MIT has anymore. And I don't know whether it was MIT people that built that large model or not, but it was a similar kind of model; it provided me with an example of what I was constructing.

The model kit was called the Kendrew Wire Model. Each model part connected by a sleeve with a pair of tiny screws to tighten it into position -- using a screwdriver, to each other part. Each of the four bases was a separate unit, flat and planar. For the molecule backbone, I had to assemble each sugar ring, attach the phosphate group, and orient all of these in three dimensional space to coincide with the positions of these atoms in the table of coordinates produced by the scientists, as a result of the X-ray analysis that they did on the crystal of the tRNA molecule.

I used a plumb line – hung from the position of each atom – to hang down to a grid at the base of the evolving structure. Where the plumb bob fell on that grid, that gave me the reference for how to adjust the position of the atom parts in the metal model high above it. Adjusting and correcting one atom, would result in others moving, which had to be checked and adjusted. The construction was an ongoing, iterative process that could have me reworking on one day something I had built some time ago. As I proceeded, the molecule took shape in space, intricate and curved in ways I had not imagined as I was doing the construction.

I later did support work in the lab. And then in my undergraduate thesis, which I did for the physics department, but under the supervision of Alex Rich, in the lab-- I computed some early computational modeling of the molecules that were being synthesized and crystallized and tested in that lab. And the molecules that I studied were, at the time, believed to be, in the test tube, inhibitors of sickle-cell anemia applications.

ABAH: You mentioned that you met your husband at MIT. Would you mind telling me the story?

CAVICCHI: Yeah. We were both students in Richard Filipowski's design class, which was under the architecture department [Professor in the School of Architecture and Planning for 36 years, the first to teach Bauhaus design philosophy at MIT]. My husband received an undergraduate degree from the architecture department. And I was taking it because I was looking for a course in art, and that was the first one.

We remembered each other from the first day, when the students would all put their work up on the board for everybody to see each other's works. His work and mine stood out to everybody, and they were kind of opposite.

ABAH: Wow.

CAVICCHI: So we had one date that year.

ABAH: Do you remember what the art pieces were?

CAVICCHI: Yeah. We were supposed to do-- The assignment was patterns, to create something that showed pattern. Alva did gridwork, like on graph paper or something. And different colors, different kinds of pattern on a square grid, like a mosaic of colors.

And mine was-- I was in my East Campus top floor, where you sat out the window on the ledge, the window ledge. And people crawled or moved around on that ledge. And at that time, there was still ivy growing up there. (They tore it down.) And so I did a black and white ink drawing of the ivy, which had, like, a curl that fit the pattern there. I loved the assignment.

We didn't really come in contact with each other until the middle of my junior year. I was making 200 bells out of clay for an art class that I was taking in the Center for Advanced Visual Studies. By the middle of my junior year, I had taken all of Filipowski's

courses and finished them. In order to continue my interest in art at the time, the only avenue that I was aware of was to take these graduate level courses at the Center for Advanced Visual Studies.

Alva was doing sound and the early music computer work. This was before the Media Lab existed. Alva worked on the music computer. He was a musician doing music composition. He became involved with the composer Paul Earls, who was one of the fellows at the Center, where I was taking their first course at the time.

So I was advised to have this sound guy, composer guy (i.e., Alva), take a look at my 200 bells. And he visited me in my dorm room, where I had some of these bells hanging. Alva talked to me about the different shapes of the bells, the sound of the bells.

And then we didn't see each other for another year. I was handing in my MIT bachelor's thesis, the Humanities thesis, and saw a friend of mine from WILG, and she said, "Oh, let's celebrate. I'll take you to the small grocery, which was in the Student Center. And she was going to buy me a soda, an orange soda. And there was a guy in the aisle-- That place had really no aisles, and he was filling the whole thing. I couldn't get around him. I couldn't avoid him. And we went on a date. And so then we started dating when I was a master's student.

ABAH: Would you mind telling me more about that?

CAVICCHI: Yeah. My advisor was controlling, intimidating, terrifying in one-on-one interviews in his office. He would yell at you. I was looking to grow in free and creative environments, and it was not like that. It was frightening. I did my thesis, I completed the degree. But I was devastated at the end of it.

ABAH: I'm sorry to hear that.

CAVICCHI: Yeah.

ABAH: Is there an anecdote from your MIT experience that you'd like to share?

CAVICCHI: I was staying in an apartment when I started dating Alva. And the apartment roommate was trying to be a professional photographer. And she told us one day that she got a job as an assistant wedding photographer to Bachrach.

ABAH: To where?

CAVICCHI: Bachrach, which is a very famous photography studio in Boston. And she wanted to know if we would pose for her, because she was going to be a wedding photographer.

ABAH: Oh. [LAUGHS]

CAVICCHI: So--

ABAH: Were you guys engaged at this time?

CAVICCHI: No.

ABAH: Or just resisting it? [LAUGHS]

CAVICCHI: I set up an entire mock wedding. We borrowed a wedding dress. We took over the chapel.

ABAH: The MIT chapel?

CAVICCHI: The MIT chapel.

ABAH: Wow.

CAVICCHI: We had a bunch of people – my friend Alanna, of course, and her friend – and we had this mock wedding. So we had the MIT chapel. And they threw--

ABAH: Rice?

CAVICCHI: --rice and, you know, the whole thing. And then we went to WILG, which is kind of a long hike. Somehow everybody walked up there, and the wedding dress or whatever, and we made a seven-layer wedding cake on the spot.

ABAH: Wow.

CAVICCHI: We frosted it. We had--

ABAH: Yeah. That is hilarious.

CAVICCHI: That was great.

ABAH: And how many years after that did the actual wedding happen?

CAVICCHI: Six months or so.

ABAH: Oh, good practice!

What is the most valuable lesson you learned at MIT? I know some lessons I probably had to re-learn.

[LAUGHTER]

CAVICCHI: If I'm thinking of myself at the end of my first four years at MIT, I know that I had entered MIT being really afraid, and thinking that MIT would crush my spirit or something like that. And I found that it didn't have to be that way, that there was a lot that I was intrigued about, exhilarated about from the MIT environment, by becoming

involved as an investigator. And there was also somehow some space for me to still be creative. Alanna's friendship made that space always present as part of the deepest way of being in the world. And somehow, I could overcome or persevere through the terrific academic stress, and at the same time be sustained by the very intriguing and lively problems that people are raising and investigating. But I don't think that I totally ever learned that lesson.

ABAH: So after you graduated from MIT, what was your career plan? And did you follow it?

CAVICCHI: Yeah. I guess I thought I would be an artist. I thought also going into the art program at MIT – the master's program – that it would be a way to do art and science together, which I had really been committed to, and wasn't really able to do as an undergraduate. But the master's program at MIT didn't pan out for me in that way. It might for other people. And again, this was only in the second year of the SMVisS Program in Environmental Art. It might have worked better for other people later.

ABAH: Under different instructors.

CAVICCHI: But then when I left there, I didn't see what kind of future I had at all. So I took courses at Mass College of Art and the [Museum of Fine Arts, Boston] Museum School. Then it transpired that Alva was going to go to graduate school, so I needed a job. I got a job at B.U. Medical School doing the kinds of things I had done in Alex Rich's lab, where I had done my UROP for almost four years.

I would continue to meet with Phil Morrison, as a teacher and friend. He and his wife encouraged me to become a physics teacher. And this was something that I would have never thought of before. And I took the courses to become certified to be a teacher in physics – a high school physics teacher – at B.U. While I completed that program, Phil Morrison hired me for two and a half years to be his researcher for "The Ring of Truth."

ABAH: What is "The Ring of Truth"?

CAVICCHI: A six-part public science TV series that was produced in 1987. Each episode was a different history and science exploration. It was to bring the public awareness of how science comes to its findings, to show you the evidential links by which science developed. Historical science experiments were reconstructed presented, as well as interviews and examples from current science with unresolved questions, such as about dark matter. Narratives in each episode were developed to reveal how and what we learn about nature, by excerpting from the ever-ongoing, never-ending activities and questioning of science. These episodes involved the history and the creative response to learning and experiencing science.

It was a very stimulating time for me to work for Phil Morrison, in support of his vision. I would support him in developing the stories and arguments that became part of the program. He was creative, investigatory, open, passionate, joyful about the world and how we seek to understand and live together in it. His mind wondered at the largest

scale of the universe, or of any question, and at the same time held in relation the units or properties of its make-up; having awe and uncertainty concurrently, intermixed.

I would do the searches in the literature, walking back and forth to use long physical card catalogues, going into the backrooms of libraries and study rooms to read and request books, taking notes on paper, following through a hint or reference that Phil remembered from his encompassing reading on all subjects. Regularly, I shared with him my notes, along with physical books and articles. His enthusiasm – and insight to see connections and thoughts for yet further possibilities – inspired me. In this close interactive way, I began to experience investigation as inherently open to always another turn, another consideration, or even overall transformation in what and how we understand. And this became inspiration for me as a teacher. Eventually, I began to wonder how learners might connect with science and curiosity, in the ways I observed and experienced with Phil Morrison, Alanna, and others.

For about six years or so, I taught high school physics as an adjunct instructor in night school engineering programs at local colleges. Eventually, I would put so much effort into these courses, into my lectures, into student papers, and I thought it didn't make a bit of difference. So I was really questioning what goes on in the classroom. My husband by then had his doctorate and was teaching as a professor in computer science.

ABAH: What did he have his doctorate--

CAVICCHI: A doctorate in math.

So I started taking graduate courses in physics, thinking maybe now I could overcome this test anxiety that I had and I can do it-- And these were tough, graduate-level courses in physics. One by one I took them all, this time doing very well academically. Again I worked almost alone, without classmates to discuss things with.

So by taking this very slow route, I was really deepening my knowledge of the basic physics, and continuing undergraduate physics that at the MIT level had been really terrifying to me. But I still didn't see how the students in the courses that I taught were actually having experiences that deepen their knowledge of physics, experiences like those I had with Alanna, in the biology lab with the molecules, and with Phil Morrison.

ABAH: Were the grades of the students disappointing, or was their understanding lacking?

CAVICCHI: I didn't feel like they were really coming to understand it, to see physics in their everyday lives and understand the relationships. Some students would. Also, I was the only woman in these classes that I taught. There were no women students.

ABAH: Wow.

CAVICCHI: I remember I taught for several years – like, three, four years – before I had the first girl in my class.

ABAH: How many students did you have?

CAVICCHI: I would have, like, 20, 18 students at a time. They would be young adults in their late 20s, early 30s sometimes, someone older.

ABAH: Are these classes at MIT or various colleges?

CAVICCHI: Wentworth Institute [in Boston]. And then I taught at what became the University of Massachusetts, Lowell, when it was Lowell Institute of Technology, I think, at that time, or it went through the transition while I was there.

I was also working in a lab there, in a chemistry lab, as a writer. And my friend there, who was the professor of the lab-- It was this friend's idea-- he encouraged me to create my own course and teach it. He suggested that I base the course on "The Ring of Truth," the TV show that I had participated in developing, which also had a companion book, written by Phil and Phylis Morrison, that I had assisted with producing.

So I created this course out of what I experienced with "The Ring of Truth." It was called "Science in Our Lives." I taught it twice in the night school program as a course for academic credit in science.

I had the idea that we're going to learn everything by lab. And the people who took it were teachers seeking to get certified to teach elementary science. They were so open, and they invented their experiments. They were delighted, and they understood new things. This was what I was looking for in physics.

It was unlike what I felt about the regular physics course where I lectured. After having this wonderful experience of teaching with the experimental setting, I wanted to do it for real, as a major way of teaching science.

As I was taking graduate courses in physics one at a time, I learned to deal with this test anxiety, and find it wasn't that I was lacking a brain. A particular test showed this to me. I proposed to do a doctorate with the thesis being the teaching of physics and creative writing. It was very controversial.

The school was not ready to commit to physics education as an investigatory realm of what physics included.

I went to the Harvard Graduate School of Education. I believe that I had more freedom and creativity there to do something that emerged from my own curiosity than in any physics doctoral program, but I didn't know that at the time. I was reacting to my own physics education, as well as the lecturing and physics education that I saw going on where I was teaching, at several engineering programs. So I didn't end up being able to impact the physics community that I had originally been motivated to address and change.

ABAH: Wow, that's a very inspiring story.

Is there anything you have done differently since you were-- If you were at that crossroad again, is there anything you would have done differently?

CAVICCHI: I was also working for a group called the American Institute of Physics' Introductory University Physics Project [IUPP], which challenged the physics community to change the way physics was being taught.

Because of the IUPP, I was aware of what was going on at that time in physics education research. And I had met many of the people doing physics education research around the country.

ABAH: How long did you spend at Harvard?

CAVICCHI: Six years.

ABAH: Did you enjoy your time?

CAVICCHI: Yeah. It was great.

ABAH: Nice.

CAVICCHI: I was trying to do a dissertation that would involve exploration of the means of learning in experimental science, where the students would be doing experiments, and that I would be doing my own investigation of the historical experiments that underlie the areas of science that my students were studying. And I would be using the exploratory pedagogy – critical exploration – but it didn't have that name at that time. That research pedagogy emerged from the work of Piaget, under the exploration of my thesis advisor, Eleanor Duckworth [former student and translator of Piaget, educational theorist and Harvard professor].

This kind of work was very unconventional. And the dissertations at Harvard at that time in the School of Education had to be approved-- the proposal had to be approved by a committee of the whole faculty of the School of Education, none of which were science educators, and few of which were even committed to teaching, to teaching as an investigatory process. It was a stressful and disheartening process.

ABAH: What did you do after Harvard? How did you get back in--

CAVICCHI: I came back to MIT.

[LAUGHTER]

ABAH: How did that happen?

CAVICCHI: As a graduate student, I took some courses at MIT, and that helped me get past some of my total terror of the whole place.

One of those classes was "Gender and Science," taught by Evelyn Fox Keller. In that course, I was a classmate with a woman who was a doctoral student at the University of Hamburg. My classmate became a visiting student at Harvard while she was continuing her studies at the University of Hamburg. She was doing a thesis on women graduate students' experiences of the research culture.-And she and I together created a class that we team-taught at Harvard. It was called "Exploring Water Through Ways of Doing Art and Physics."

Our class experiences involved students with observing and exploring water in many different creative modes, including: playing and being with water outdoors, using hoses, water spray, water toys, child swimming pool; constructing fountains and water flow effects in the lab with cups, soda straws, tubes and dish pans; observing and drawing individual water drops, in their shapes on wax paper, cloth and other surfaces; observing and photographing the waves and surface patterns on water in a ripple tank and other containers; making paper with water and fabric; contact printing with water and light.

Student reflections and student projects embraced physics and arts in creative ways, such as a student fountain formed by developing 100-foot-long head of water via a plastic tube that ran the height of a many story building, and an artist's journal of observations of water made on paper that she handmade in a process involving water.

Our students reflected on how the class experiences and discussions open for them the possibility to be aware of the connection between seeing and responding to beauty in the world, and learning about the physical world and its behaviors. Course participants were teachers who developed in their personal vision of creative experience in teaching and learning.

After I graduated, my co-teacher had returned in Germany to complete her dissertation. Without her, I taught that course twice more in two successive years. That was my first few years out of Harvard.

I also taught with another collaborator the course that is the science education course for high school teachers planning to be science teachers at Harvard.

CAVICCHI: I applied for the postdoctoral fellowship at the Dibner Institute of Science and Technology, formerly at MIT. You would be among a group of seven or eight first-year postdocs, and then the same number second-year postdocs, and then about 10 to 15 senior researchers in history of science, math and technology. And we worked on our own research in any area.

ABAH: [LAUGHS]

CAVICCHI: A really great community of people. You presented your work once a year. People would respond to it. And you responded to other people's work. Very lively. A wonderful community, with the resources of MIT.

I was trying to redo a historical experiment, an electrical experiment. I found out about the Edgerton Center. And I started coming there to do my experimental project. And eventually, the Edgerton Center encouraged me, saying, "Why don't you teach this kind of thing?"

ABAH: Wow.

CAVICCI: So I started the course [EC.050/090 Re-create Experiments from History] in 2005. It's now 10 years that I've been teaching this little seminar. I have a few students at a time. It's been as many as seven or eight-

Together with teaching, I was able to do research writing that would convey the message of exploration – curiosity as the basis of learning. The learning that I didn't see happening in those lecture classes that I was teaching and taking. The actions of the learner on the material and their mind, together with their hands and whole experience – including their emotions, which Piaget observed in young children – that I could make this happen for adults, together with this complicated physics and historical material. All of us are explorers. And all of us can learn and learn more deeply and creatively and lastingly in these kinds of experiences.

My historical research on the creation of the historical experiments and studies suggests that historical experimenters and students learn through exploratory experiences. Historical scientists don't always write it up that way. But by either recreating experiments or looking in alternative ways into the written records of historical works, you can see their struggles, too, and it's not always what's popularly depicted. There's real potential for all of us.

ABAH: What is your favorite experiment to create? Since you've been doing this for 10 years, do you have a favorite?

CAVICCHI: Yeah. I guess I'm intrigued by surprises that come up, surprises and realizations happening together. And I like to see the thinking of the learner become accessible while they are experimenting with light bulbs or little motors, or things like that. You can follow what's happening. Watching shadows, seeing the effect on the relationship of the sun in space-- the effect when light goes through a hole. I think maybe that across my teaching-- that was something that I did in that group with the teachers-- but letting a bright image pass through a pinhole or a small hole, and you project it onto a screen. What that looks like and what happens is very surprising and exciting.

ABAH: [LAUGHS]

I looked at your CV. You have a lot of different publications. I couldn't even print all of them!

CAVICCHI: [LAUGHS]

ABAH: So when did all of these happen? Did they happen during your time at teaching this course, or did they happen at Harvard? When did you publish all this?

CAVICCHI: Well, mostly when I was not teaching. A major story that I was researching as I did my fellowship I have yet to write up, which I feel sorry about because it would be great for people to know that story.

ABAH: Do you still have all your notes and records? Will you be able to write--

CAVICCHI: I hope so, but I can't yet visualize what it would be. I began to go to international conferences. And it's only in the international community where there are people who are doing history and science teaching, and historical research, and recreating of historical experiences in the classroom or as research. So going to international conferences has been a wonderful experience for me in meeting these communities of people.

ABAH: How did you get to know about the international conferences?

CAVICCHI: I came into contact with one of these Dibner postdocs while I was doing my doctorate at Harvard. I was introduced to him. And he was very supportive, because he saw that I was doing something similar to what he was doing. There was an analogy. He recommended that I apply for the Dibner. And then he told me about the conference, my first international conference.

ABAH: Where was it?

CAVICCHI: It was in Como, Italy, the most beautiful place in the world.

ABAH: [LAUGHS]

CAVICCHI: So it was really a personal friend and a colleague; otherwise, I wouldn't have done it. I would never have thought to go outside the United States. I was going to physics meetings. I didn't have advisors who knew about these conferences.

These conferences sometimes ask you to write a whole paper, or they want to put together a book. Now, the book is a small number of copies, only the number of copies are made for the number of people at the conference, except a few more.

One of these conference papers of mine is in a Portuguese book. My paper's in English. A friend translated the abstract into Portuguese, so that at least people would have some context for it. In another case, a professor from Mexico requested I write a paper for a book. I wrote the paper in English; she had it translated to Spanish for the book.

ABAH: Is there anything else you would like to share?

CAVICCHI: Well, I guess I didn't talk about being an artist, which I still try to do.

Being an artist, I didn't totally give up on the idea that I could do art, although I never saw myself as being a professional. I wasn't trained to do what you have to do to be a professional artist. I tried a little bit to learn about what that would be like, but I have never tried to sell my work, or hardly ever exhibited it. I did find out about a teacher of woodcarving. And for about seven years, or more than that, I took regular classes with him. I did woodcarving sculptures.

And I just continually did watercolors, sometimes oil paintings, but watercolors on my own from, let's say, 1980 on. And it's thousands of paintings now, not exhibited. I used to make a lot of woodcut prints. And then I could make multiple copies, and I would give people these prints.

I also did a project that was part of "The Ring of Truth," of observing the moon by telescope and painting it. This is my first reconstruction of a history, because Galileo did this, and I was following him.

My first exhibit in decades was last summer, during a conference on history and science teaching, in the college at Rio de Janeiro [CEFET/RJ, Rio de Janeiro]. And the high school students helped me put it up. We had 70 or so drawings and paintings.

I just try to do art in my spare moments.

I do wonder, now that I really understand – as a researcher of learning and teaching – what it's like to be creative, to develop creatively. I wonder if I could ever set aside more time for me to do creative work – artwork, or experimental work, or the both combined – and really focus on that, with the awareness that I've built up of the creative process. And I'd be curious to have the opportunity to give that a try sometime.

ABAH: Is that your next step?

CAVICCHI: I don't know. [LAUGHS] It could be, though.

ABAH: So actually, my last question was going to be, what do you look forward to, but I guess we have an answer.

CAVICCHI: Yeah, maybe so.

ABAH: I definitely think you should think about writing a book about science discoveries, and putting your art out there, certainly because you have such a massive portfolio on your resume. You should definitely explore that.

CAVICCHI: The exhibit in Rio de Janeiro, the young people who helped put it up, they felt thrilled and honored to be part of it.

ABAH: Did you manage to sell any painting at the Rio de Janeiro--

CAVICCHI: I didn't even try.

ABAH: [Did you say] you have a business idea?

CAVICCHI: For the retirement celebration of Eleanor Duckworth, a group of her former students got together to plan the celebration. And we came up with the idea, like they do sometimes for famous professors, of putting together writing – physics papers – and they'll give these physics papers as a gift to the person who's retiring. You might have heard of that [a Festschrift].

So we were going to do that with people who were teachers who had used the exploratory teaching method. And we put together-- we solicited from her students and friends-- letters, poems, journal articles, essays, descriptions of teaching experiences. We put together a book: 50 different authors, each one a few pages in there. And we produced it as PDF in the Harvard bookstore, printed it as a book. Critical Exploration Press is the name of our new company, and we're going to print and encourage exploratory education.

ABAH: That is great.

CAVICCHI: We're reading websites about how you start a business.

ABAH: Nowadays, no one really needs to go to business school, in my opinion. All of the information is online. Everything is online!

CAVICCHI: Yeah.

ABAH: Thank you so much for your time. I really enjoyed talking with you.

CAVICCHI: Oh, that's great.