# Visiting Critical Exploration in the Classroom

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## Abstract

In this commentary, summarized from a recent interview, the author reminisces about a career dedicated to critical exploration in the classroom. She discusses the formation of the Moon Group, a group of teachers who met over a period of 25 years to study the behaviour of the moon. Duckworth later describes an exercise in which her students experimented with the positioning of a small mirror in the classroom in order to be able to predict where to place it on a wall so one student can see another in a different part of the room. In another exercise, she had university students observe the learning of children by having them solve spatial problems without any advice or prompts from an adult. She concludes by providing guidance for classroom teachers, emphasizing the importance of making sure, "what you want them to learn is worth learning about."


### Discovering Piaget and Inhelder

When I finished my BA, I wanted to go see the world and I won a Rotary Fellowship which sent me to Paris with $2,000 for the year—ALL MINE! And I had money left over at the end! Although I had done my BA in philosophy, I wanted to do graduate work in psychology. I'd never heard of Piaget, but he was on the course schedule that I was required to take. His very first class swept me away—it appealed to my young philosopher's heart. His lectures that year were about geometry—and he pointed to three different kinds: Euclidean, projective, and topological. Historically, Euclidean came first. Theoretically, the base is topological, from which we devise projective and Euclidean. Piaget's question was: "What was the order in which children's thinking developed?" The answer his observations and interviews had led him to was that children's geometric thinking was topological, first; Euclidean and projective developed later. That's what he was lecturing about that year, and it fascinated me.

Then, I found some financial support to continue in Geneva and went there as a student full-time for the next two years. I continued to be overwhelmed by his theories. And I took part in the research, as all students did—as note takers. My first year, I had the good fortune of being the notetaker for Barbel Inhelder, Piaget's coauthor. The second year, I was a research assistant and did the interviewing myself, with a note taker to help. That was really fascinating for me. I was giving kids interesting things to think about, devised by Piaget and the research group—actually that year he was back to studying children's approaches to topology. I loved it. I always wanted to prolong the conversations with the children. I wanted to see what they thought about this point of view and that point of view. I was fascinated by watching how they handled conflicts in their own thinking.

When I came back to the United States, I signed up for a PhD program, but I dropped out of it. Nothing was anything like as fascinating as Piaget, so I wasn't enjoying it. But it meant that now I needed a job.

By then, 1962, Piaget was known by the education world in North America, and, although I had no particular interest in education, I found that that was where I could easily get a job.

## Elementary Science Study

My job was with the Elementary Science Study, which was developing science curriculum for elementary schools. I knew nothing about science, nothing about curriculum development, nothing about teaching—but I knew more than most people about Piaget.

Most of the staff were research scientists who took time out from their careers to spend a year or two working on elementary school science. They were terrific and I had a wonderful time. This organization had a biology lab, a physics lab, a woodworking shop, a metalworking shop, and a film studio. The film studio we had to share with a few other projects, but the others were all just ours. What they didn't have were kids. So as they worked away on their curriculum and the materials that would engage kids their subject matter, they tested them all out on me.

I became the sample kid, and I was a student of practically all their absolutely wonderful curriculum. That's how I learned all the science I know, from my colleagues at the Elementary Science Study. It was a wonderful education. On the whole though, I didn't know what on earth I was doing there. I didn't see how I could be helpful to anybody. I was happy to be this child, but what else could I possibly do? When we started to go into classrooms, my colleagues would try out the materials with the kids and I would talk to the kids to see what they were making of it. That was where I found that I could be useful. I knew how to talk to kids without telling them what I wanted them to say. I was able to learn what they were thinking about the materials. That was what I was trained in, in Geneva.

## The Subject Matter of Teaching and Learning

I eventually went back to Geneva and did get my doctorate—17 years after I had received my Master's equivalent there. By the time I got to my position at Harvard, I knew that in my courses I wanted to show kids at work, having them think through some of the problems that were developed in Geneva; I wanted to have my graduate students read articles by David Hawkins, the first director of the Elementary Science Study—a philosopher of science and a wonderful man who had learned a lot about teaching from his nursery school teacher wife, Frances Hawkins; and I wanted them to watch the moon. I had gone back to Geneva and done some teaching and that's where I developed "doing" the moon, but it grew out of the Elementary Science Study, which has a unit about watching the moon.

In my experience with the Elementary Science Study, I learned that my scientist colleagues all loved their particular subject matter, and wanted to share their love and wonder with teachers and children. They wanted to give the students experiences of the phenomena that had given rise to their own wonder. They were not interested in giving the students *words* about these phenomena. If my subject matter was teaching and learning, how could I give students experiences that would raise wonder? I came up with three things.

One was, I would demonstrate with kids this way of asking them questions about what they thought, so as to help students see that kids have a lot of ideas, are willing to think hard for a long time, and can go far in their own thinking without being told the answers.

Another was having my students do that themselves, as homework. People did what they had seen me do—with their nieces, neighbours, roommates, uncles, people hanging out in Harvard Square, and anybody they happened to know. They were practicing the craft of getting somebody to consider some issue, to come up with their own thoughts, and to get somewhere further in their thinking without being told anything.

The third, and very major, thing was to have the students be learners themselves, in the way I wanted them to learn and wanted them to teach.

Their final project, building on these three kinds of experience, was to have the students choose their own subject matter, and devise their own materials and activities for getting people interested in it—trying it out as they went along—with one or two learners.

So those were the three elements that did end up creating, in my students, new wonder and love for teaching and learning.

## Observing the Moon

Subject matters that I had students study as a group, for a day or two, included a poem, the mirror problem, and a math problem: "What are all the ways you could lay out four paper clips, each of a different colour, side by side, and how can you develop a system which would enable you to be certain that you had all of them with no repeats?" But the subject matter that we studied for the entire semester was the Moon—what were its habits. They were to document their observations of the moon every day—keeping a record, as often as they could, of when and where they saw the moon was and how it looked.

And then in class, we talked about what they saw, what was surprising, why this was surprising, what was beautiful, what they appreciated and what they had observed that seemed to be a regularity, what puzzled them. They would ask each other to help out by paying attention to something specific, in their own upcoming observations. If the timing was right, we would go out at the beginning of class and see where it was and predict where it would be at the end of class two hours later. Figuring out how to mark where the moon was at the beginning was already one challenge. We would go out together two hours later and see how their predictions turned out, and what further questions they raised.

The moon is available for everybody, and there are some regularities you start to see in a couple of days. You say, "Oh my goodness, it's doing that. I wonder if it will be doing that at the same time tomorrow." Some things one can get quickly, some things would take a month or two to see the regularity—others longer.

And as people start to see the regularities, they start to try to figure out how come that's how we see things. What are the moon and the earth and the sun actually doing, so that we see what we see in the sky? Then they would try becoming the objects. Someone would be a sun, another a moon, and another the earth. And they moved each other around and tried to figure out, how it would look if we were like this and this? It's very tough spatial thinking to figure out what's going on in the sky and on our Earth for it to look to us in some specific way. That takes an entire semester, and it is far from finished after one semester.

Before I started teaching the Harvard course, I spent a few years in a project at MIT with Cambridge elementary school teachers. Part of the project had involved studying the moon, and after the project was over, six of them wanted to keep going, studying the moon. The Moon Group met, I think, every two weeks for about 25 years. Details of some of our later work is in an article, "Twenty-Four, Forty-Two, and I Love You: Keeping It Complex," which can be found as a chapter in "'The Having of Wonderful Ideas' and Other Essays on Teaching and Learning" (pp. 141 to 154). The Moon Group got deeper and deeper into how the moon moves and what's going on in the solar system that results in the movements we see. We stopped for a while, after the 25 years. But we're just now coming back together. We're now starting on light, and reflections. We probably don't have another 25 years to go, but we're starting on light and reflections.

## The Mirror Exercise

The mirror exercise requires a plain wall preferably without windows or doors in it. Two students stand up, Mary near one end of the empty wall and Jeremy opposite the other end, but on the other side of the room. We have a little mirror, and the question is: "Where should we put the little mirror, flat against that wall, so when Mary looks into it she sees Jeremy?" And I would have people go and put a little pin or a piece of tape or something on that wall to show where they thought the mirror should go—without saying why. And then I'd have everybody pick one of the marks on the wall that is *not* where they think the mirror should go, but that they think they know why the person thought that. At that point the job is trying to figure out what ideas or thoughts might give rise to this prediction—an important exercise for a teacher. And then people went into little groups to work on where in fact the mirror would go, and how to predict where the mirror would go if the two people move.

I would usually end with laying the mirror in the middle of the floor. It was always a big class of about 50 people. We would all stand up in a circle, and by looking in that mirror on the floor, found somebody on the other side. Everybody saw somebody so there we would be—all 50 people in one little mirror. Quite an astonishing thought! In one class, someone said if the light photons or whatever they are, are bouncing from the mirror to Mary, and she is sending others bouncing off the mirror to Jeremy, how come they don't hit each other and bounce back? And so, Mary would see herself again. It got right into the question of the—well, how does light work, anyway? I certainly don't know the answer that question. I asked my physicist friends and they said, "Well, really, we don't quite know the answer to that question yet." It was quite amazing.

## University Students Learning From Kids

When children come to the class, I tell them, "I want you here because most of the people in this room are teachers, and I know that most teachers think that they have to tell you things, and if they don't tell you things, you won't ever know them. And I don't think that's quite true. I think that you can learn a lot of things without being told them. So, I'd like you to show them that."

The students would watch them work, try to figure out what they're doing. One of the major things I liked to show the students is a question about volume. I'd have some little blocks, two centimetres cubed, and then a solid block—the size of four by three by three of the little cubes. And then I had a whole lot of cubes the size of the little ones. "That big block is a chocolate bar and the company that makes it thinks it's not a very good shape. They'd like exactly the amount of chocolate that's in it, but it's not a good shape for a chocolate bar." And the children agree: "Yes, it's not a good shape."

I would ask, "Could you build another shape that has just the same amount of chocolate in it?" I usually worked with two kids at a time and I'd give one of them a two-by-two square and another a two-by-three rectangle—two blocks on top of two blocks, or three blocks on top of three blocks. They were to build out along the table from the original square or rectangle, adding little blocks until it would make the same amount of chocolate as the original block. One 10-year-old, after working for a while, looked at the big block, multiplied, and came up with 36. He started adding squares (that was the shape he had been given) —aiming to add 36 squares! And when he saw how long the chocolate bar was getting, he exclaimed that 36 would be far too many rows. He had the appropriate numbers, multiplied them together correctly, but he had no idea what he was supposed to do with the number that gave him.

If they get interested in how many little blocks make up the big one, they often take the outside area for the volume: "There's 12 on this side, 12 on this side, 12 on this side and 12 on this side, that's 48 and there's nine up here. That's 57 and there's nine down here. So there are 66 in there." Some kids see no problem with that. And that's okay. Off they go not getting it today. Others are perplexed and work hard at figuring out what might have gone wrong in that calculation.

The children usually worked about 45 minutes and then had a 15-minute break. During that time we would discuss what they had done and decide among ourselves what questions to ask them next. And when the children came back I would do what the students had told me to do. Then the children would work again, sometimes as much as another hour. They just worked. If they were intrigued by this question, they just never wanted to stop, which is fascinating to see. The students would notice how hard they worked; and how much silence there was; and that I didn't tell them anything, and yet they learned; and that I never said yes or no to something they thought. The students were able to see both what the kids were doing and what I was doing.

## Advice for Classroom Teachers Who Embrace the Notion of Inquiry

Make sure that what you want them to learn about is worth learning about. And then find some intriguing little part of it, to command their interest. Commit yourself to having the students really experience this subject matter. Give them the math problem and let them figure it out or give them the scientific equipment and raise one question or give them a history document and let them make sense of it and then have other backup documents to pursue their ideas. So, you never have to say, "Yes, you're right, or you're wrong." You just get them to keep thinking, your job is to keep them thinking about this subject matter. And your job is to find materials that will keep them thinking.

**Eleanor Duckworth** was born in Montreal; her schooling was in the public schools of Montreal and Halifax before she ventured into the wider world. A former student, research assistant, and translator of Jean Piaget, she grounds her work in Piaget and Inhelder's insights into the nature and development of understanding and in their research method, which she has developed as a teaching/research approach, Critical Exploration in the Classroom. She seeks to bring a Freirean approach to any classroom, valuing the learners' experience and insights. Her interest is in the experiences of teaching and learning of people of all ages, both in and out of schools. Duckworth is a former elementary school teacher and has worked in curriculum development, teacher education, and program evaluation in the United States, Europe, Latin America, Africa, Asia, and her native Canada. She is a coordinator for Cambridge United for Justice with Peace, and is a performing modern dancer.