

Computing Educators Oral History Project

An Interview with *Mats Daniels*

Conducted Tuesday, June 29, 2011

In Darmstadt, Germany

Interview conducted by Barbara Boucher Owens

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1 [0:00]

2 **Barbara Boucher Owens:** This is an interview with Mats Daniels, being conducted on the
3 29th of June, 2011, in Darmstadt, Germany, by Barbara Boucher Owens. This interview is
4 part of the Computing Educators Oral History Project.

5

6 Did I get your name correct?

7

8 M: Yes, you did.

9

10 **B: Good. Well, we start these interviews way back when. Okay, so we start out with: Tell**
11 **me about your parents — like their education, their work, their ... did they have**
12 **computer-related careers. Tell me about them.**

13

14 M: Oh. Well, my parents are both teachers. My mother in history and Swedish; my father in
15 math and physics. My mother was in the ... upper elementary, like year seven, eight, nine.
16 And my father was at the next stage, the high school, eleventh. And he also eventually
17 became headmaster of the school in Mora. And ... well, what can I say, I mean....

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19 **B: What was your father's field?**

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M: My father's field was math and physics. And it's ... he went to Uppsala University to study that and astronomy. And my mother ... I mean, I think they met at the teacher training college where they ... I'm pretty sure my mother didn't go to the university level to get educated in Swedish or history. I think it was history. What else could I say?

My father's background was growing up in a small country town in Dalarna [a region of Sweden]. Probably the first in his family to actually go to the university, but this is 1950s and at that time, the number, the proportion, of the population that went to universities were quite low. So I guess it's not that strange that he didn't — that he was the first.

My mother's father, he was also in physics. Well, he didn't get a Ph.D., but he was at least on the verge of getting towards one in Lund.

B: Your mother's father?

M: Yes. She grew up in Stockholm, which is like the big city in Sweden, the capital.

You said something about where I was born. They ... I was born up in the north, in a small town at the Finnish border. And that's because that's where both of them could get a teaching position at the same time. So my first three years I was living up in a town ... I have no memories of it. But it's kind of cool to actually have been born farther north than most other people. So yeah. But they are basically teachers. And especially my father is really into ... really loving academics.

B: Is he still actively an academic?

M: Well, he's retired now. But he's really been enjoying doing math with my daughters as they are doing ... they are becoming engineers. Or one is an engineer. He was actually ... he did one of the math tests — I think Calculus 2 or something like that, the test my daughter had. So he was doing it just for fun and, since I knew the teacher, I sent the exam to him. He actually graded it. [My father] turned out to be best in the class [Barbara laughs] and he really sort of loves math and this is ... I mean, he's 81 now and he still sort of ... well, at the moment, he's reading Transform Theory because that's a class my youngest daughter is going to take a re-take exam in sometime. So he ... this is a new area for him, so he's been reading the book and wanted to contact the teacher to discuss some of the things. I was just ... he loves math. Gauss is his god. That's the type of person he is.

[5:12]

B: So, you said you were born in this tiny town on the Finnish border, but where ... and you said you only lived there until you were three.

M: Yeah.

B: Where did you grow up?

65 M: I grew up in Mora in Dalarna. And that's ... well, not a big place either, but it's in the heart
66 of Sweden. It's been described as the best-known small place in Sweden. Many people
67 consider Dalarna to be really the heart of Sweden. So it's a town of, like, 20,000. But it's the
68 central part of a large area; north and northwest towards the Norwegian border, there is just
69 small villages. So this is the central town in a rather large area.

70

71 **B: So tell me something about the type of school that you went to and what was the**
72 **community's attitude toward education, what was your impression of school.**

73

74 M: Well, I mean, I went to school in the 1960s and early 1970s and ... well, I think the general
75 attitude towards school was ... well, in my family it was kind of clear and important. This is
76 ... this is something important and I always knew I wouldn't stay where I grew up because if
77 you are going to go to university you have to move to another place. And so in that sense, ...
78 well ...

79

80 **B: But what was it like? You're a little boy going to school in Dalarna. What do you**
81 **remember? Do you remember particular teachers? Do you remember particular**
82 **subjects? Do you remember talking about it?**

83

84 M: Well, yeah, I think I kind of, in a way, since both my parents were teachers, I think I was
85 thinking about what the different teachers did in the different classes and maybe noting it
86 more than I otherwise would have. The way things were done. I mean I had a German ...
87 teacher in German, who I ... well, he wasn't really doing teaching the way I think ... he was
88 a bit tough in some sense. But he also really loved the subject. And I remember that making
89 it something I took more serious than I otherwise would, because ...

90

91 Math and science have been rather, sort of easy for me. Swedish, or language, has been a bit
92 harder, probably because I'm approaching it more in a sort of natural science way or not
93 being confident in how to tell stories or how to make things eloquent, what do you say,
94 elegant? I don't know. It's sort of ... I didn't really feel confident or didn't really feel I got
95 the encouragement in that area, which is kind of strange, because now I really think language
96 is fun and interesting and something that's really intriguing. How it works and how you can
97 use it. But at school, it really sort of ... And then English was a pain [Barbara laughs], so I
98 dropped English and kept German, probably because of that teacher who got me going with
99 German.

100

101 So yeah, I think ... but also, I mean in high school, and also in upper elementary school,
102 there were quite a few who really didn't take studies seriously at all. It was just something
103 you did or went to. So, I don't know ... it was a time. I enjoyed going there, but it wasn't ...
104 yeah. It's hard to say ... trying to remember. I mean, it's something I took for granted: "This
105 is important. This is something I will do." And most of the things I enjoyed doing.

106 [10:28]

107 **B: Did you have friends that you studied with or that shared that value of education? Or**
108 **were you ... ?**

109

110 M: Well, I think if I look back at the friends, we were probably ... the ones I was spending the
111 most time with were students who were good in school. Although I don't think any of them
112 actually went to the university out of the ones I spent most time with.
113

114 **B: Mmm hmm. Did you have ...**
115

116 M: One of them, he actually went to work for Apple in one of the early years and I think he did
117 well. But he certainly didn't go ... he wasn't the study type, in some sense. He was bright,
118 but not ...
119

120 So I don't think I could say that I was in a group where we were taking studies seriously. It
121 was ... we did different things and I guess most of us were ... didn't have a problem with the
122 subjects.
123

124 **B: What did you do for fun?**
125

126 M: Oh, I was ... part of the time I was doing athletics and skiing. So I was competing in skiing.
127

128 **B: In skiing?**
129

130 M: Yes, cross-country skiing.
131

132 **B: Cross-country.**
133

134 M: Yes. And then upper teenage, we went out to dances and having parties, so ... But it was ...
135 Yeah, I was spending a fair amount of time doing training for cross-country skiing ... it's a
136 bit time consuming if you want to be at least semi-good at it.
137

138 **B: Did you have any siblings?**
139

140 M: Yeah, I have a brother who's two years younger.
141

142 **B: What path has he taken?**
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144 M: He's a ... we both went into engineering at Uppsala University and even though he's two
145 years younger, we didn't really spend all that much ... we had different sets of friends and
146 he's ...
147

148 He's in computing, though. He's just recently changed from ... he's been a security expert at
149 PTT [Televerket, the national phone company]. Now he's going to move into a consulting
150 company, still working in that area. But I think part of what he's doing is research in that
151 area. So, in a way we have ended up in similar places but not quite, because, well, since I
152 stayed in academia and he went out and made money.
153

154 **B: So, through high school, you said that science and math were easy for you and that you**
155 **worked harder in German. But you had to decide where you were going to go for your**
156 **higher education. How did you make that decision?**
157

158 M: Well, it was ... actually I did ... I can't say this was something I really, really wanted to do. I
159 had been looking at engineering education and I also was contemplating going for this ...
160 what do you call it? Keeper of the woods?
161

162 **B: Is there a Swedish term for it, because we can translate the Swedish.**
163

164 M: Yeah, I do remember that as well. It's ... I wonder if it's ... it might be jägmästare in
165 Swedish. But there's a higher exam where you're sort of ... your job would be to know about
166 how to maintain forests. That's another side of it.

167 [15:04]

168 My father loves math, but he also has a love for the forest. We have some patches of forest in
169 the village where he grew up, in the small village outside [Rättvik]. And so he's, part of the
170 time, he would be out there maintaining patches [of the forest] to make sure they are kept
171 well and so ... well, the forest has been also part of my growing up.
172

173 **B: So you were deciding forestry or math and science or ...?**
174

175 M: Yeah, at least I remember putting both those things on the table, thinking seriously about
176 them. And it seemed like engineering would be keeping more options open. So I think I ...
177 most of the time I'm making choices by trying not to narrow down my options and trying to
178 do things that I feel comfortable with. So ... and I guess Uppsala, that's the closest university
179 to where I grew up. There were other universities that I could go to: Royal Institute of
180 Technology, Linköping has a ... maybe it's a younger place than Uppsala and their education
181 seemed not that bad, but eventually I put Uppsala as my first choice. That's right where I
182 ended up.
183

184 **B: So when you got to Uppsala, as you're starting to study, what program did you ...?**
185

186 M: At that time, they only had engineering physics; that's the only engineering degree they had.
187 And at that time, it was a four-and-a-half year program. But towards the end you could
188 specialize in materials science, electronics, computer science, or ... there was a fourth one as
189 well, more theoretical — physics, I guess. So ...
190

191 **B: Had you done computing prior to going?**
192

193 M: Not really. I had done ... in the last year, in high school, there is this special project. And I
194 actually ... my special project was to learn some BASIC. And I remember I needed to go to
195 Borlänge — that's a city like 100 kilometers south of Mora — to actually get to a place
196 where I could run a program. I mean this is 1974 ... was it 1975? 1974 I think.
197

198 **B: Was it time-sharing system for BASIC? Or was it BASIC on cards?**
199

200 M: No, it was ... that was on cards, I'm pretty sure. I ...

201

202 **B: Did you go down there and stay?**

203

204 M: No, no. I went down there. I mean, I was preparing and then reading about it. And I ... yes,
205 there was another place in Mora where they actually had a computer and I was doing some
206 study visits there, but I didn't do ... I think the only place I could actually do some small
207 programming, that was in Borlänge. And it wasn't a big project. But at least I had ... I was
208 doing something that was connected to computing. I mean, this is ...

209

210 **B: Tell me how an 18-year-old kid — you were probably about 17 or 18 then?**

211

212 M: I was ... yeah, 17 or 18, yes.

213

214 **B: Okay. How did you connect with these people and what kind of a place was it?**

215

216 M: Ooh. I actually don't remember.

217

218 **B: That's okay.**

219

220 M: It's OK, I probably didn't connect that much at all. I mean ...

221

222 **B: Well, you had to know somebody, right? A teacher ...**

223

224 M: Yeah. It must have been a connection my father had with someone. I would assume it would
225 ... it's a bit scary, I really don't remember who it was.

226 [20:00]

227 **B: That's okay. That's okay. But you already ... so you had some interest when you went**
228 **there, when you went to Uppsala?**

229

230 M: Well, the interest was sort of like this seemed like something that's going to be useful. It's
231 not something I burned to know about.

232

233 **B: So, now we're in Uppsala and you've decided at the end of your time at Uppsala to**
234 **specialize in computer science. Were there any particular teachers in your sciences —**
235 **you can even start back in your secondary education — but teachers that were big**
236 **influences on you? And then when you got to university as well?**

237

238 M: Well, first of all, there is one-year military service between high school and university.

239

240 **B: I forgot about that, yes. What did you do for your service? Was there ...?**

241

242 M: I was — what do you call it? — indirect fire director. I mean, my ... I was leading a small
243 group of — I think we were four — we were supposed to be out there and looking where
244 grenades ... where they would hit. So we would signal back, "You have to change because
245 the grenades aren't hitting the target."

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B: Were you using math to do that?

M: Uhh ... math came in, of course, because you had to know about where are you in relation to the target and using your knuckles in order to make some sort of estimation about where are the things hitting and where do you want them to hit. And you have to make some calculations about how to direct.

So yeah, math came in and I'm pretty sure ... I mean, that position ... I got that because, I mean they do some rather thorough testing, two days where they test you for your capabilities. And it's also a rather physical position because you have to be in front of where all the others are. So I guess having the skiing background and math and also at that time my eyesight was pretty good. So yeah, math played a role in that.

And if you go back to ... I mean, the first programming class, my memories from that — they started out with BASIC and since I had done this project two years earlier, BASIC seemed like it was a piece of cake. I don't need to spend that much time on this. And I do remember when they actually switched to FORTRAN halfway through. And I sort of thought, "Well, one language is the same as another." And suddenly I was realizing that's not quite the same and there are differences and maybe I should start to pay a little bit more attention to what is going on. So it wasn't ... it wasn't an eye-opener class. There was a bit more struggle than needed because of my not really paying attention for things then. But apart from that the first two years were really just a lot of math and physics and theoretical physics.

Then in the third year, we had some math class and I think the computer organization or computer architecture classes. I did find that ... that was an interesting class and I think the teacher there was in some sense making a difference in a way. I mean, it may be a bit sad, but this is the third year in university studies and this is where I, in some sense, felt like, "Yeah, this could be interesting." The other stuff was more like, "Yeah, let's do it," especially the math classes I had.

[24:45]

I mean the scenario of this education was you had three courses in parallel and we had a four-quarter system. So you had like twelve courses each year, every one more or less looking the same: lectures in the first two weeks typically contained 40 hours of lectures every week. And then, towards the end, you had assignments and labs and less lectures. And the time wasn't really enough, at least I thought, to really learn math. So instead I learned how to pass a math test. And you could ... the thing was you got ... sitting at lectures, taking notes, doing whatever homework they assigned you. And then, towards the end, when you got to the exam period, I got a number of old exams and you went through them and found some patterns and what they were actually asking for and how to solve some of them. And that typically would be enough to pass the test. I mean, of course, I learned something but it wasn't ...

B: I never go this way in an interview but I will for you because you've opened the door. How that experience form how you teach and how you view education now?

292 M: Well, I think it does some, because it's sort of ... it ... I think it's been influencing me in a
293 way that I know that even if you are interested, if there is an easy way out, time can really
294 make you go for that. And also, if you have an education where things are getting
295 predictable, lots of students are going to learn how to deal with the predictability of the
296 examination rather than on the content of what you're learning.
297

298 **B: So are you trying to break that cycle or do you try to ...?**
299

300 M: Well, I try to make sure that there is a variation and also that ... a variation in the way things
301 are examined. But also in trying to ... get beyond not getting engaged. Trying to make sure
302 that there are things engaging throughout the course.
303

304 And also I did ... my fourth year, I went to Case Western Reserve University [as an
305 exchange student]. And there ... I mean suddenly I was in a place where teaching was done
306 differently and ... for instance, we ... I mean you know the American system. In Sweden, we
307 are ... every week has an individual schedule. Like I said, 40 hours of lectures in the first two
308 or three weeks in a period. That's pretty ... that's a lot of information. I mean, the idea there
309 is that you should get to a point where you can do stuff. And then coming to Cleveland,
310 having in some classes one hour or one meeting a week, I mean it was strange because it felt
311 like nothing is happening. I guess in a way we were supposed to read more at home, but that
312 sort of wasn't the way studies had been before for me. So I guess ... and then we had these
313 first exams ... and then ... that was also ... I mean, the exam was spread out. Typically, in
314 the way it was in my education, it was a final exam and that's where everything was decided.
315 And suddenly I was in a system where they could have ... they had a midterm, you might
316 have even quizzes that actually counted toward the grade. And also, most of the courses I did
317 take was a semester-long course. And to me that was — apart from the first start where I
318 didn't really get started because things were ... I mean, it sounds like I didn't get enough
319 information to do anything.

320 [30:04]

321 But after a while, this felt ... it was something that suited me better than the way I'd been
322 studying in Sweden. Because ... yeah, the way it felt like when it came to finals week. I
323 mean, the idea that, I think one of them, we had three courses and they were all examined
324 within twenty-four hours. That would never happen back in Sweden. There had to be at least
325 two whole days between two exams. And [in Sweden] the exams were like six or seven hours
326 long and in Cleveland they were three hours. And they were ... Actually the content of the
327 exams were a bit different too. But the main difference was, I think, I was prepared in a
328 different way for the exam. I didn't need or didn't ... there wasn't time to actually do the
329 cramming for the exam. At least, I didn't feel like it. Not the way it was in Sweden. Although
330 I did see Americans who were behaving more or less the same as I had back home.
331

332 But also when we came back — we were six of us, six Swedes going — it was kind of
333 interesting. Because the way ... there was definitely a shift in grades. I got better grades in
334 the American system than in the Swedish system and some of the others, the opposite
335 happened. I guess that's another issue that sort of colored me. I'm ... don't get me wrong, I
336 think grades are important, but they are not an objective measure, I mean, that's the way I see
337 it. You ... sometimes people pay a lot too much attention to what grade did you get without

338 thinking about what did they actually measure to give you that grade. What did they look at?
339 So in a way, partly what I've been colored by is seeing a grading system that doesn't really
340 measure learning.

341
342 And also, coming back, one of the agreements from going to Case was to also do the
343 Master's thesis at the department. And also ...

344
345 **B: Which department: Uppsala or Case?**

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347 M: In Uppsala. And also giving feedback to the program coordinator about the differences
348 between the systems, because he was interested to learn from it, because ... and actually, he
349 made some changes. He did reduce the number of lectures, trying to ... and also pushing in
350 that there would be more of a continuous examination, more like the American system. I
351 mean it wasn't a total shift. But there was changes and there were discussions about
352 educational differences and the pros and cons about doing things. So there was a discussion
353 about pedagogy that came from this.

354
355 **B: What did you do your Master's thesis work on?**

356
357 M: Oh, I did that ... I was writing an operating system for one of the new Intel [8086] systems.

358
359 **B: So, it didn't have anything to do with pedagogy?**

360
361 M: No, no this was in the Computer Science department. Although actually at that time the
362 Systems group was part of the Department of Technology at that time. So it has roots in
363 control systems. There was a guy in the control systems that liked computers and then we
364 formed a subdivision in computer systems.

365
366 **B: And who was that?**

367
368 M: That's Björn Persson. Later became a professor at Royal Institute of Technology. I would
369 assume he's retired now. And then, after I did my Master's thesis, I got enrolled as a Ph.D.
370 student. I mean that more or less just happened. And it ... I had always been interested in
371 education, so it fitted.

372 [35:22]

373 **B: So can you talk to me about what was going on in your life at that time? You got your**
374 **Master's. When you were going to school in Sweden were you being paid? How were**
375 **you ... as a teaching assistant or ... ?**

376
377 M: When I did my Master's thesis I also had a TA position. So it was half-decent salary and I
378 was helping out with teaching computer architecture. Not just being a TA actually, I was
379 doing part of the lecture. We were a group of three or four, actually, who was doing teaching.
380 And then ... I mean, this was 1980 and none of the staff actually had a Ph.D. in computing.
381 They had Ph.D.s, but in other engineering or control systems or something like that. And
382 some didn't have Ph.D.s either. So actually coming up as a Ph.D. student, the status was
383 more or less to be a lecturer. During my first year as a Ph.D. student, I was part of a team

384 teaching computer architecture and I was the main teacher for the operating systems class. So
385 at that time ... not all but most of the Ph.D. students were also really teaching courses.

386

387 **B: So then you finished your Master's. You were starting on your doctoral studies. What**
388 **happened then?**

389

390 M: Yeah, well ... well, I guess I tried to find an area where I was going to do ... I mean, there
391 was no professor in the area and so my actual supervisor was a professor at the Royal
392 Technical Institute of Technology — although that was more on paper than in reality. So
393 Björn Persson was my acting supervisor. And I guess I eventually moved into formal
394 methods, describing communication protocols, describing computer architecture, describing
395 timing aspects of it. And I guess it was fun and interesting to do, but I also wanted to do it a
396 little bit differently than what he wanted.

397

398 I do remember we had a meeting with the professor from KTH [Kungliga Tekniska
399 Höskolan, the Royal Technical Institute of Technology], just me and a friend of mine. We
400 worked rather closely together on this formal methods. We had designed a language based on
401 finite-state machines, or extended finite-state machines, to do this. And Björn wanted us to
402 take this more into production — or no, or a tool. So my friend was going to write a compiler
403 for that, for our language, into something that could be runnable. And I can't remember what
404 he wanted me to do.

405

406 But I was more interested in actually looking at that from how you can actually describe
407 things. So when this professor came, he had this discussion and then I actually made the
408 mistake of actually talking about what I wanted to do. And he said, "That sounds good!" And
409 then we sort of ... he just said, "Well, that sounds good. Do that." And then he spent a lot of
410 time talking about my friend, about what he was going to do. And he was questioning him:
411 Was this really going to be good enough? Is this really Ph.D. work?

412 [39:59]

413 And as I remember, it was a bit of a discussion there and I felt pretty good. I was like, you
414 know, this guy is behind what I want to do. Which was, in a way, a mistake, because he was
415 not really part of the research team. And, as it turned out, my friend, he had the support and
416 Björn ... he really did what he was going to do. So he went straight ahead and did this
417 degree, Licentiate degree, between a Master's and a Ph.D. And then he went over to do a
418 Ph.D. as well. I more or less got stuck because ... well, the communication between me and
419 Björn didn't go all that well after that meeting, I think. And I took ... I think it was in 1985
420 where, if I'd done things in the proper time, I would have, should have, been sort of close to
421 getting a Ph.D., whereas I was actually getting my Licentiate degree instead.

422

423 **B: Your what degree?**

424

425 M: Licentiate degree. It's this midway degree. Well, I guess it's the same now. A Ph.D. is
426 supposed to be a four-year program after Master's and this Licentiate is supposed to be a
427 two-year — full-time, since you're doing TA or working as a teacher. You don't work full-
428 time as a researcher. And doing this as a Ph.D. student, one has a salary that's pretty okay

429 actually. It's not a super salary, but that's ... at least for someone going out into industry the
430 first couple years, it's almost comparable. So it's ...

431

432 **B: So, you were, as you said, stuck. What did you do career-wise?**

433

434 M: Well, I did get my ... that degree.

435

436 **B: That middle degree?**

437

438 M: But around that time there was this change where the subgroup in computer systems formed
439 a department of its own and at the same time quite a lot of the senior staff went over to this
440 Ph.D. institute of computer science, which was more of a research organization. So in 1985
441 ...or I think it was ... yeah, I think it was in July. It might have been halfway through 1985,
442 that's where this official change was done and I actually got a teaching position instead. And
443 I stayed at the department, whereas Björn and a few of the more experienced researchers
444 went to the Swedish Institute of Computer Science. Some, but not all, had like a 20%
445 position also back at Uppsala. I mean, in order to get something running, because it was a
446 large drain, brain drain, from the department. So since ... I guess from 1986, I was a full-
447 time teacher.

448

449 **B: So, in this full-time teacher role did you supervise Master's students and graduate
450 students as well?**

451

452 M: Well, it depends on what you mean by graduate students.

453

454 **B: Well, Master's. It would be Master's students, I suppose.**

455

456 M: Yeah. So, yes and they also had ... in 1981, we started a computer science education
457 program, a four-year program. So around the same time as I ... so in 1985, it was the first
458 time we had all the years in place for this new program. So we had substantial more teaching
459 to do because of this than we had. It was a fairly successful program. Good students coming
460 in. And so educational-wise we were sitting in a good position with interesting courses, good
461 students, and also teaching engineering students from in the program I took, the latter part of
462 the engineering physics, had computing courses.

463 [45:28]

464 Actually, it's a side thing: when I taught the operating systems class, I had my brother in the
465 class.

466

467 **B: [Laughs] Really?**

468

469 M: So he actually has had my mother, my father, and me as teachers.

470

471 **B: [Laughs] Have your children had you?**

472

473 M: No. No, I would feel uncomfortable with that.

474

475 **B: The other way! [laughs]**

476

477 M: I guess so.

478

479 **B: Let's try to ... one of the reasons you are such an important part of this project is your**
480 **ability to work internationally and your great mentorship of many people. Do you want**
481 **to talk a bit about that transformation, how you got so involved internationally and how**
482 **you became a mentor all over the world to people?**

483

484 M: Yeah. Well, partly I think doing my year at Case Western was opening my eyes to the
485 importance of ... well, to me it was an inspiration to do ...to go somewhere and try to adapt
486 to another system. It was ... I felt inspired and I felt like ... a bit like ... yeah, I put in more
487 effort into the studies, partly because I thought ... I think it mattered that I wanted these guys
488 to think well of us back in Sweden. There was sort of a pride thing there, I think. It sort of
489 motivated me and I think it was the same for most of the other Swedes who went. And also
490 you put in some ... you had to make an effort to make this happen. And once you've done
491 that, you want to use this effort. It was kind of like you can't just waste spending ... making
492 this sort of decision to go somewhere else and do something. It's becoming a commitment, I
493 think. But that's aside.

494

495 The other thing is that, well, becoming a teacher, full-time teacher, was like ... I still had ... I
496 mean, research was also something that I felt like I wanted time to do this, but ... well and
497 then I got this invitation from People to People to come on a China trip, a trip to China —
498 which was sort of like I don't know why I got it or why I paid attention to it, but it sounded
499 like an interesting thing to do, to break what I was doing in a way.

500

501 **B: You and I both know what People to People is, but probably the people reading the**
502 **interview might not know.**

503

504 M: Ah!

505

506 **B: You want to give a little description of what was involved?**

507

508 M: My impression of it was that here is this organization that's trying to bridge boundaries
509 between countries and making ... placing ... taking, in this case, teachers, to go to a country
510 and then to ... this time China ... to visit ... to sort of ... I don't know. I mean, it's also ... I
511 think there is some sort of wanting to "spread the light" in some sense. But it's also about
512 actually getting the people going, knowing about the place they go to.

513

514 So it sounded like an interesting thing. And since it was about education, which I really — I
515 mean, being a full-time teacher, I was, of course, interested in how to make education better
516 because I was ... I was part of the programme committees, where you discussed the structure
517 of your programme, educational programme, what kind of courses you had. And I had
518 opinions based on my experience, seeing that there were some limitations or some things that
519 I didn't like in the programmes. So yes, I had some sort of desire to know more about how to
520 make this better.

521 [50:27]
522 But it was kind of expensive, so it wasn't something I could really pay for myself. And I jus
523 ... I asked my head of department if he could sponsor me and he said, "Well, I can give
524 some," he said, "but not all of this." So I wrote a letter to the Vice-Chancellor. And he
525 actually got back and said, "Tell me more about this" and actually gave me money to go, so
526 ...

527
528 There was like seventy people, most Americans. But I think for me what I got of that was
529 maybe not as much the contacts in China, but within the group is where I ... Many of them
530 were very active in the SIGCSE community. At least Liz Adams, Bob Aiken, Joe Turner. I
531 mean there were people who were in many ways great door openers into this community. I
532 also met Joy Teague from Australia and through her I got a connection to places in Australia.
533 So a couple of years later I went down, doing a year in Melbourne. But I think that trip gave
534 me a lot of contacts and it also introduced me to going to SIGCSE. To go to a place where
535 they actually talked about educational issues. So I started to think, "Well actually, one can do
536 research in this as well." And it ... I don't know, I mean, it's also where I found the value of
537 knowing people, knowing people in different places, knowing about them.

538
539 And another consequence was also that eventually I became the Director of Undergraduate
540 Studies, so I had more control over who was teaching what. And you know you came for
541 three months to teach. We have had John Impagliazzo; we have had Carl Erickson, Dawn
542 Cizmar, Vicki Almstrum. There is some guys from Australia with us.

543
544 **B: Nell [Dale]?**

545
546 M: Nell has been there. We've had ... Cary Laxer came for a time.

547
548 Well, actually being out there, being in the international arena talking with people, being
549 visible, has made things happening both locally and for me personally. And I guess also, I
550 think, me and what we are doing is also influencing outside.

551
552 And part of this was when Carl Erickson came over, he wanted to do some development
553 work. And we used the opportunity of having him there for a year to apply for a grant, a
554 development grant, to run a collaboration course between his home university, Grand Valley
555 State University, and Uppsala. And we got that and that project was a national project for
556 three years, fairly well financed. So through that I can bring people like Marian Petre, Sally
557 Fincher, Mary Last. And also Mary Last, she got her Ph.D. based on looking at that
558 collaboration. Anders Berglund did the same. Martha Hause in the Open University also got
559 a Ph.D. based on that. So ...

560 [55:26]

561 It was ... well, things just started rolling. Doing things internationally had some momentum.
562 It doesn't roll by itself, no. But the Runestone project — that's what we call that one — is still
563 running, even though Grand Valley State isn't part of it any more. We've had Rose-Hulman
564 Institute of Technology for a short while. Now it's running with Åbo [University] in Finland
565 and Tongji [University] in China, so the basic idea is still in place. And we also started
566 another.

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I mean things ... it's going places, meeting people, there is ... makes things happen. One thing was in ... SIGCSE was in Dublin ... oh, ITiCSE was in Dublin, I met Tony Clear. And he had some ideas that he wanted someone to collaborate with. And three weeks later we had a collaboration where my students were working with his students. That collaboration lasted for eight, nine years. And then there were some changes that unfortunately — at least I think it's unfortunate — we dropped that collaboration.

But we also started another collaboration with Rose-Hulman Institute of Technology, where we've had this IT in Society class, where we've been — since 2004, I think — we've been collaborating with them. I think many of these things happen because you know people, because you can trust people and even though ... and also it just happens because ... I guess I've seen the importance of having local support for running things. And in Uppsala I can provide that myself since I have the position. But I think there is some sort of experience one can build on to make this, and there are ... and actually seeing both the hard parts and the good parts and trying to focus on the good parts.

B: That's a wonderful, wonderful answer. And it kind of combines all of the questions I have about professional service, professional organizations, the impact. And you've mentioned using ... getting involved in SIGCSE. You've sponsored one of our — twice — you've sponsored one of our conferences and been involved in many of the ITiCSE conferences.

Did you want to talk anything else about your professional service, those kinds of ... the organizations, the things you've done?

M: Well, one really. It's like my friend, who we were working together with early on. He later on moved to Västerås, a smaller regional high school ... well, higher ... it's not really a university, but it's close. It's like a community college, but it's bigger. I remember once that he said to his teachers that, "Well, you can actually look at the teaching aspect of the education and just look at Mats and his colleagues. They actually do get to travel. They get to see people. They are writing papers. They are ..." I think it was interesting to hear that I was mentioned as a role model, as an inspiration, for others to try to get involved in this community, in trying to not just look at subject research. That there are more things to being a teacher and some of them is something you can actually do research about. So that's it.

[60:18]

It has been changing. It is more recognized. I mean, when Anders defended his Ph.D. in 2005, there was a pretty important, or a portal figure in Computer Science, who stood up and said, "Well, this is just plain wrong. This is not a thesis that belongs in the Natural Science and Technology faculty. This is something that should be somewhere else, in pedagogy or ..." And when I defended my thesis, actually 30 years to the day after I enrolled — it's kind of cute — there was none that sort of ... had any question about that this is a valid research area within our department.

And we also had an international — well, when you get a new Vice-Chancellor, they typically try to do things. And the one sitting now is running towards the end of his period.

613 So when he started, he had this quality evaluation of everything research-wise in the
614 university and now it's getting ... he was running this again. And our research group was
615 definitely put forward in the department as something to show.

616
617 So I think things are happening and I feel like I'm part of making that happen, because — not
618 saying this is something to do in a corner, but this is something that is important. This is
619 something you can show to people. This is something that makes things happen, that makes
620 education better. And education is a big part of what we're doing. I mean research, yes, that's
621 important, but there are the teaching, the education, the understanding what's going on. I
622 mean, we do have a lot of people, students come in, spending a lot of time, money on being
623 there. We should be professional about what we do.

624
625 **B: I think people call it the “elephant in the room,” that we haven't really talked about.**
626 **You did mention that 30 years to the day after enrolling, you got your Ph.D. And that's**
627 **a little longer than most take. [Laughter]. Can you describe what gave you the energy to**
628 **go back to getting a degree and how you chose the topic that you chose?**

629
630 M: Well, it's a ...

631
632 **B: And how did you get the support for it? I guess those are the three questions.**

633
634 M: Um. Right. And ... well actually, you should read Chapter 2 in my thesis, it's about telling
635 the ...

636
637 **B: We'll definitely put a link to that in the interview transcript.**

638
639 M: But what happened is ... I think Vicki Almstrum is an important person in this. Because
640 when she came, she had a Ph.D. in something that seemed to be ... it wasn't really
641 computing, but it was very much based on computing or understanding computing
642 educational aspects. And it was in a teaching setting I think, I'm not quite sure. But anyway,
643 having her for a year at our department — I think it was 1995, something like that, or 1996,
644 I'm not quite sure — but it became obvious that this is something one can do and I really had
645 started to think about it.

646
647 I wanted to do research and in 1989–1990, I went down to Melbourne to try to restart in
648 formal methods — I was working with a professor there — and actually got some papers
649 done. But I really ... my heart wasn't there any more. And I really was more interested in
650 education. So eventually going to the SIGCSE conferences, realizing I can write papers in
651 this. And then ... because of the way it was earlier in the 1980s, when we really didn't have
652 Ph.D.s, because people in teaching positions like me without Ph.D.s — Anders Berglund was
653 one of them. And there was a push from the university to actually get rid of these people. Not
654 get rid of them, but to give them a chance to get a Ph.D. because it looks better to have
655 teachers that have a Ph.D. than those that don't. Partly I guess. That's one of the cynical
656 reasons.

657 [\[65:39\]](#)

658 But anyway, there was money in there and Anders, he was going to start doing some
659 research. And I think he felt like —he’s actually in my position here — he’s trying to ... he
660 was talking to one of the supervisors about doing something in using Ada and he started. And
661 I said, “But Anders, look, where’s your heart? Why don’t you try to do something in
662 computing education instead?” Eventually he — and his supervisor was the head of
663 department at that time, he was pretty ... — he said, “Yes, there seems to be some
664 possibilities here.” And there was this national school that was a project that Anders actually
665 also got involved with.

666
667 So anyway we had started to do more scholarly work, more research in education, started to
668 publish. So I was in a way starting to do research. Although I guess for a while I felt like,
669 “Yeah, I want to get my Ph.D. before Anders gets his!” [Barbara laughs] But he was more
670 dedicated and I had more administrative duties, I guess. So then he got his and I had
671 actually got the senior lecturer position ten years ago, something like that, based on having
672 the equivalent of a Ph.D. So getting a Ph.D. wouldn’t get me higher up on the ladder of
673 positions, so I didn’t have that incentive. But it was ... I got some money, some projects
674 running. I had a good time. I was doing things I wanted to. I got to travel. I got to do the
675 research. So it didn’t really feel like I needed that.

676
677 And then we ... well, eventually I got into the position of actually supervising one of the
678 Ph.D. students we had with Lecia Barker. And so he graduated a year before me. And
679 actually seeing him, following him through this process, I think that sort of made it ... “Oh,
680 this is so ridiculous. I mean I really should do this!” [Barbara laughs] And then I talked to
681 Arnold Pears and Michael Thuné, who were — Michael Thuné is the research professor in
682 computer science education research, because we have this area, research area at Uppsala.
683 And he’s a professor in scientific computing, but he’s quite interested in education.

684

685 **B: So Arnold was your supervisor?**

686

687 M: And Arnold ... yes. He was Anders’ supervisor as well. So I talked to him and I said, “Well,
688 how do you view this?” Because I didn’t want to, as you say, go back and do this. I wanted to
689 say, “Look here’s my publication record. Here are the things I’ve been doing. It should be
690 enough. But can we agree on ... I’ll choose a number of these publications, I’ll write
691 something about that. And that should be enough.” Because I really wanted to make sure I
692 wasn’t in a position where they would come and say, “You need to do this, this, and that.
693 You need to do some more studies or some ...”

694

695 Well, eventually they decided on five papers that were going to be representing a story that
696 would be something I could write something about. And that’s ... and it was actually fun
697 writing. I had a good time, it was ... and I didn’t really get any time off to do it, rather I was
698 kind of doing it ... well, yeah, I did get ten percent [time off], a research grant from the
699 department last year, in 2010. But I guess I did the work ... most of the work was done in
700 January/February of this year [2011], finishing up the thesis. Maybe it’s happened I think
701 because ... well, people were kind to me and avoided ... if it wasn’t really necessary, they
702 didn’t come to me to ask me for things. So actually writing the thesis was giving me, in some
703 sense, a more relaxed time than normal.

704 [71:02]

705 **B: That's very interesting.**

706

707 M: Yes! But it was fun. And it was ...

708

709 **B: Good! I mean I have never seen anybody's dissertation process get as much excitement**
710 **as this whole community that you've built. When you received your Ph.D. there was a**
711 **worldwide, community-centered "Hurrah!"**

712

713 M: Yeah, it was fun. I've heard from people ... I think I handed in my thesis for printing just
714 before SIGCSE. And I heard back from people saying, "Well, this was mentioned."

715

716 **B: Yes, yes, yes. Can you ... we've covered most everything. We're getting kind of down to**
717 **the end of the interview. One of the things ... were there any particular challenges that**
718 **you think you've met. You know, big walls that you had to overcome. One was, I think,**
719 **the professor who didn't value education and supported your friend. And didn't value**
720 **... generalizing formal methods rather than a product. That was a wall.**

721

722 M: There was ... when I think back there's one time when I felt hindered by not having a degree

723

724 **B: Oh, okay.**

725

726 M: Or actually by not being a professor, because that was ... there was ... there were ... there's
727 this rich family in Sweden. And they had decided that they were going to sponsor a
728 collaboration between Stanford and Uppsala and KTH and another medical hospital in
729 Stockholm. So I was actually part of writing up what this collaboration was going to be
730 about. Then, at the next step, when it was time to actually split up money to put people in
731 place, I felt totally sidestepped by politics and by not being a professor. I really felt
732 handicapped. So even though I ... we had the collaboration with Grand Valley State; we had
733 experience with running international collaborations on a grand scale. At that time we had ...
734 each year typically a hundred students working together in an international collaboration.
735 And that was going to be part of what this project was going to be about. And yet they were
736 sort of like ... yeah, I felt frustrated. Let's put it that way.

737

738 **B: Yeah, yeah. But now you have a Ph.D. behind you. Will that qualify you for**
739 **professorship?**

740

741 M: Well, it's ... actually you don't need to have a Ph.D. to get a professor.

742

743 **B: Ahh!**

744

745 M: There are examples of people who have been brought in from outside who have actually
746 become the professors and later on actually getting a Ph.D., more or less for fun, I guess. But
747 there is no formula. I'm not quite sure. Or put it like this: If you ... within academia, you
748 can't go that way. You have come from outside and you have to be a special case. And then
749 you can be.

750
751 So now there is ... Yeah, I can go forward on an academic career. The next step in Sweden
752 would be a docent [position]. One of the ... well, the most famous professor we have at the
753 department, he actually asked ... because Arnold got his ... made his docent-lecture just a
754 couple of weeks after I had my Ph.D. And this professor came up and asked me if I was
755 doing this. Because he thought it was ... well, since I'm actually more or less overdue doing
756 a Ph.D., he thought I was doing it for fun, to actually get the docent [title] as well right away,
757 which I didn't.

758 [75:24]

759 **B: You did?**

760
761 M: No. I didn't. No, but I'm probably going to write together ... write up trying to apply for that.

762
763 But there is ... another reason is that there are European grants that are based on ... there is
764 one junior research grant for researchers between ... who have a Ph.D. that's at least two
765 years back and not more than seven or eight years back. So in two years ...

766
767 **B: You will be a young researcher.**

768
769 M: I think I will be a young researcher [Barbara laughs]. I hope that my record would be a bit ...
770 making me in a good position to apply for those grants.

771
772 **B: That's a wonderful story. We're going to completely shift gears. Tell me some of your**
773 **current outside interests and the role of your family. Things that are outside computing**
774 **that affect you.**

775
776 M: Well, one of the things that happened that ... Well, if you go back to 2001, that's where I
777 turned 45 and most of the people who went to Cleveland with me [as exchange students at
778 Case Western University] also turned 25 ... oh 45. [Barbara laughs]. So I think it was in May
779 we met, maybe at my birthday or something like that, and then in August we met again —
780 there was the birthday of someone else — and his wife said, "Have you seen Ove?" And I
781 said, "Yeah, he was around." But what she meant was that he'd lost like 20 kilos between
782 May and August by starting to run. And I guess that made me think ... because I had been
783 skiing before, but then getting to university and all that, I just didn't do it. I did ski the
784 Vasaloppet — that's a 90K race that ends in Mora.

785
786 **B: I'm familiar with that race, yeah.**

787
788 M: So I did run it four times in the early 1980s.

789
790 **B: Uh huh.**

791
792 M: So, I wasn't really in the shape I was when I was competing, but I was in pretty good shape.
793 So but since 1985 I hadn't been doing much training. I mean, when I did start I got a sore
794 foot or something, sore knees, and I stopped. So in 2001, in August, I decided, "Well, now I
795 need to ..." I also, we have the department on the fourth floor and actually getting out of

796 breath going up [the stairs] didn't feel right. So I started to say, "I'm going to run. I'm going
797 to run. I'm not going to run hard. I'm just going to start running for the sake of it." And so
798 I've been running pretty regularly since then. And now when I ... one of the things I got at
799 the party after my defense was the department has given me a start in the Vasaloppet again
800 next winter.

801
802 **B: A what?**

803
804 M: They have paid for my registration to ...

805
806 **B: Oh, to do the race!**

807
808 M: ... to run the ski race again. The ski race. So I guess I need to get back to ski training again.

809
810 **B: Well, since you brought it up — and, again, there will be a lot of non-Swedes listening**
811 **to this — that race has a historical significance, if I remember.**

812
813 M: Yes.

814
815 **B: Do you want to just ...?**

816
817 M: The basic story is that ... I think it was Gustav Vasa, the Swedish king, in 1520 he went up
818 and tried to gather people to come and fight the Danes, who also had been invading Sweden.
819 And the guy, he tried to gather people in Mora and they said, "No, no, no, we don't want to
820 do that." And then he fled towards Norway. And the story is that these guys decided, "No,
821 no, we need to actually fight!" So they ran after him and they caught him just before the
822 Norwegian border and then they brought him back.

823
824 So in the 1920, I think, they started to think, "We need to celebrate this in some way, because
825 this is one of the great stories!" Because Gustav Vasa, he was a good storyteller. He actually
826 made a lot of stories about — half of them are probably not true at all! — about the way he
827 was doing in order to protect himself or to get the people to come and fight the Danes. So
828 they decided to have this ski race from Sälen — it's on the Norwegian border — down to
829 Mora. So it's a 90K race. And it's been running — except for two or three years when there
830 hasn't been enough snow on the first Sunday of March — every year. There is for the main
831 race — that's the first Sunday of March — there are like 17,000 –18,000 skiers that start in
832 it. So it's just amazing to see.

833 [80:58]

834 **B: How many finish?**

835
836 M: There are ... I think that, typically you would ... I think the dropout is like ... somewhere
837 between 1,000 and 2,000.

838
839 **B: Oh!**

840

841 M: I mean some of them aren't really prepared. Some of them really get blisters. And some of
842 them just don't ... It's a pretty ... it's not a bad ... most people actually do finish.

843

844 **B: How long does it take?**

845

846 M: That's a problem. When I did the skiing in the early 1980s, my best time was five-and-a-half
847 hours, something like that. And the winners were typically doing it in 4 hours. It varies based
848 on what kind of conditions ...

849

850 **B: What do you anticipate your time will be this year?**

851

852 M: The problem is like at that time I was actually allowed to stand the second section. And I
853 think that there are at the moment, they have ten sections, based on your sorting. And since I
854 haven't been skiing at all ...

855

856 **B: You'll be with the slow guys.**

857

858 M: ... I'm now put in the last of these.

859

860 **B: Yeah.**

861

862 M: And that's going to be ... I don't know how many will stand there, but when I ... the thing is
863 you start by two kilometers on a field and then you hit a mountain. So it's like ... and things
864 get really rough, relatively narrow and things slow down. So it's like a cork, it gets clogged
865 up totally. And so if you're in the way back, you're going to lose half-an-hour, an hour
866 before you get there. And even standing in the second line, it was sort of getting slow. So,
867 that's my excuse for not ...

868

869 **B: Well best of luck and now you can say it was because of....**

870

871 **You told me both your daughters are in engineering.**

872

873 M: Yes.

874

875 **B: You want to talk anything about them?**

876

877 M: My oldest, Sara, she's doing this systems in technology and society. So that's an engineering
878 program that the previous headmaster, he ...

879

880 [A siren test sounded outside the conference center, so we have deleted the parts of this section
881 that are unrelated to the interview itself.]

882

883 M: No, I was saying, he [the previous headmaster] wanted the engineers to be more broad-
884 minded. So he said, "We're going to start this and I want roughly half of the classes to come
885 from the social sciences." And I think this program has been good. I really like it, because
886 they do ... partly because they attracted more women. Relatively half of them were women,

887 which is certainly not the case for the IT or some of the others. And it really placed
888 technology in a context. And they also get training in expressing themselves. So they are ...

889
890 Well, there is this sort of tension, I guess, there. "These aren't real engineers," some say. But,
891 at least when Sara got out, she got the same salary as other engineers would get. And they've
892 also been doing some studies and these students really get ... they are pretty ... they get
893 positions and they are pleased with the positions they get. So that's ... I think it's a good
894 program. It's ... and I think it mirrors some of the things I ... I mean, in my thesis, I'm
895 talking about competencies. I think we need to broaden up, open up the eyes of our
896 engineers, that there are ... you have to think about where to use your engineering skills, or
897 your computing skills. You have to be able to communicate. You have to understand the
898 society in order to be heard. So I think these students ... so it's been kind of interesting to see
899 her go through that.

900 [85:34]

901 My other daughter, Hanna, she's a bit halfway over in engineering ... or in energy systems.
902 And it's also been a bit frustrating to see. She's struggling more, I think, because that's more
903 of a traditional engineering program. There is less time to officially understand things and
904 she is more of a kind who *wants* to understand. And that's pretty annoying to see someone
905 wanting to understand and that's actually hurting the study results. So ...

906
907 But I think it's interesting to see the education through the eyes of your children, because
908 they are ... I mean they're important persons in your life. It's kind of ... yes, you're not
909 objective about what they see, but again it's ... I think there is some insights one can get
910 from actually seeing what's going on there.

911
912 **B: How has your family support through this last going through the Ph.D., I mean, were**
913 **they ...?**

914 [86:46]

915 The issue of support from families ... it's a relevant question though. Because I think when
916 you look at the typical Ph.D.s, there is ... it does take a lot of energy and focus. And
917 probably makes people distance themselves from ordinary life for a while. But I didn't feel
918 that in my case, because I was just more wrapping up something. This was ... I mean in a
919 way I had more time. I slept more than I did before.

920
921 **B: Yeah! It sounded like it was quite a good two months, the finishing up was.**

922
923 **In the very end do you have any piece of advice that you'd like to tell the world?**

924
925 M: Well, I think it's ... I think to keep the eyes open. I mean, I think there are so many
926 opportunities out there and trying to learn from what others do. I mean, they ... it's probably
927 nothing you can take right away — you can't use it the way they are using it — but there are
928 reasons for why things are done. And trying to understand them is probably a very useful
929 way for you to grow in where you are, in your place.

930
931 **B: Would that advice be different to a young woman? This project started as a way to**
932 **encourage women and you have done a wonderful job of encouraging women. I've**

933 **watched that. So is there different advice you'd give to a young woman, to your**
934 **daughters, to other women interested in technology careers from that you offer males.**
935

936 M: Hmm. No. I think ... and also if you talked ... I would advise to really ... to do things that
937 you believe in, people ... things that you actually are interested in. Try to do things ... well, I
938 mean I try myself to sometimes force myself to do something that I didn't feel quite — force
939 myself, that's maybe not the right word — but it's been so much more fun to do things that I
940 believe in and that I feel is important and that I'm interested in, really interested in. I mean,
941 it's like you ... it's like whenever ... and if you work with something and you meet someone
942 and you don't feel like you want to talk about what you do, you should start thinking about,
943 "What am I doing?"
944

945 **B: Mmm hmm. Mmm hmm.**
946

947 M: I mean it's like ... I think here [at the ITiCSE conference], listening to presentations, meeting
948 people. There is almost always something relevant, that feels like, "Yeah, I want to know
949 more about this." Or, "I want to talk about what I've seen that's relevant to what they say."
950 And it's ... I think it's also about reading. I mean ... well, at least if one after a while doesn't
951 really feel an urge to read more or want to ... then maybe one should rethink what one does.
952

953 And for females, I don't know. I mean, it's like ... well, to me, I think ... there are things that
954 are ... well, if you make a difference. I mean, I think that's ... some say that's something that
955 appeals to girls more than to boys. Or maybe not that, but if you don't appeal to usefulness,
956 boys can cope with that better than girls. I think that's probably ... there's some truth to that.
957 And there are opportunities here. I mean there are ways you can get ...
958

959 **B: So you're really essentially saying, "Pursue your passion and stick with things that you**
960 **can be passionate about."**
961

962 M: Yeah, that's what I'm saying. And also that ... I mean just realizing that there are a lot of
963 those options in our field. And there is a lot of need for putting technology in context. And ...
964 yeah, to know more about how this works — it's a field that needs a lot more working. And I
965 think it's something that quite a few other people who come to conferences like this are
966 already good at. And especially if they dare to step outside of the natural science way of
967 doing research. Because, there are other ways and they are also ... I mean, they might not
968 end up with a definite number as an answer, but there are methods that are useful, even
969 though they aren't based on science, natural science.
970

971 **B: Well, this has been an intriguing interview. I thank you so much.**
972

973 M: Well, thank you. It's been fun.
974

975 **B: Thank you.**

976 [93:09]