FUTURE DIRECTIONS IN COMPUTING EDUCATION SUMMIT PART TWO:

INSTITUTIONAL CHALLENGES TO SUPPORTING AND GROWING COMPUTING EDUCATION RESEARCH

A report of the March 24-25, 2014 summit held in Stanford, CA.

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Institutional Challenges to Supporting and Growing Computing Education Research

Executive Summary

A summit was held at Stanford March 24-25, 2014. It focused on the structural issues inhibiting the growth of computing education research (CER). Summit attendees identified four different challenges and opportunities:

Hiring and promotion of CER faculty: The CER community needs to decide how best to position new PhD's doing CS Education research such that they can be hired into computing (including computer science and informatics) academic units (departments, schools, or colleges). Further, the CER community needs to identify fair means to evaluate tenure, and promote computing education researchers? Clearly, having senior faculty within a computing unit who appreciate the computing education research and are sympathetic to the needs and constraints of a new field are critical.

Advocating for the discipline: The CER community needs to advocate on behalf of computing education research. This includes formulating the important research questions, demonstrating their relevance to all areas of computing and showing that we as a community have the ambition to answer those questions for the good of society. The community needs to identify clear definitions and grand challenges for the field. The January 2014 summit focused on identification of a set of significant computing education research areas and questions. Answering these questions could have a significant, positive, and disruptive impact on much of the computing landscape.

Growing the community of computing education researchers (faculty and PhD students): It is necessary to create the models by which we can use resources to develop more computing education PhD students who can be successful in answering important computing education research questions. While it is likely no single model will be appropriate for all schools/institutions, a set of successful approaches needs to be identified and supported.

Couching CER as a "disruptive technology": A strong justification/rationale needs to be provided to convince department heads/chairs, deans, and other senior administrators to support the efforts needed to grow this community. For example, being able to produce more and better software engineers in less time would have a dramatic impact on the software industry. Being able to develop computer science teachers for high schools would likely have an enormous impact on the diversity of computing professionals.

INTRODUCTION

This summit resulted from a successful NSF grant proposal 1332686, where the focus on the grant was to convene a pair of meetings exploring future research directions in computing education research, and identifying the necessary structural changes needed to support PhD students in computing education research (CER). This workshop, held on March 24-25, 2014 in Stanford, CA, focused on the latter issue.

BACKGROUND

Math education, biology education, physics education, chemistry education, and engineering education all exist as distinct research disciplines within the content area. It is possible to get a PhD in any of these areas. And yet, despite the fact that more than 150 schools offer doctoral programs in computer science [1, 2, 3], computing education does not formally exist as an "accepted" research sub-discipline within any of those computer science departments. While a few individual faculty members in computing have supported students doing CER, in general, if one wishes to pursue a doctorate in computing education, one is relegated to a limited number of programs within schools of education.

Over the past few years, there have been several changes that perhaps warrant a revisiting of whether computing education should be allowed to stand as a legitimate research discipline within computer science. Perhaps most significantly, in 2006 Jeanette Wing wrote "Computational Thinking" [4] and the resulting discussions both inside the CS community, as well as outside, have led to an interest in many questions relating to computing education and computing education research, as well as a renewed interest in K-12 computing education (and K-12 math/science education has been a driving force for supporting interest in math/science education research). Perhaps just as significantly has been the recent arrival of MOOCs. While promising to democratize higher education, the successes of MOOCs have been, to date, quite limited. (While MOOCs are certainly not limited to CS instruction, it has been computer scientists leading the charge in the creation of MOOCs, so it is not surprising that a disproportionate percentage of the MOOCs have been computing-related.) These MOOCs remind us that teaching computing is hard – and it is especially hard as we do not have in depth knowledge about how students learn computing.

In response to this situation, NSF has supported two meetings. The first, run in January 2014, focused on the most significant research questions facing computing education research. This summit focused on structural issues. Invitations were sent out to faculty in computing and in education from schools that either had students who have been graduating with PhDs in computing education or had expressed interest at the departmental/college level to support such students in the future. Additionally, individuals from the CRA were invited to attend. The summit was attended by the individuals listed in Appendix B.

Summit

The summit agenda can be seen in Appendix A. The process selected was designed to maximize conversations between attendees, both as part of small sub-group discussion as well as part of larger group conversations. The major discussion topics were:

a) Job opportunities for CER PhD graduates
b) Institutional challenges to supporting CER PhD students at participants' own institutions
c) Concrete steps that can be taken to overcome these institutional challenges
d) Existing models of successful CER programs
e) Potential partner departments, given the interdisciplinary nature of CER
f) Hiring of CER PhD graduates at participants' institutions, and getting these researchers tenured and promoted
g) The Disciplinary Based Education Research (DBER) model, and how it has worked in other STEM disciplines

Below, details of the discussions of each part of the summit are provided.

Keynote Address: The need for Computing Education PhDs in Industry

Andrew Ng (CS faculty member at Stanford, chairman of the board at Coursera, and chief scientist at Baidu) gave the opening keynote address. His talk focused on the need for computing education PhD graduates. He noted that there was a need for such graduates in academia, but also in industry. While there are clear needs for such CER graduates at education-related companies, Andrew remarked that there are other CS sub-disciplines that NSF supports (he provided robotics and computer vision as two examples) where there were not large numbers of jobs in industry for those disciplines specifically, but that PhD graduates had no problems securing jobs both in academia as well as in industry. Thus, Andrew noted that the CER community should not be concerned about availability of specific jobs in industry for CER graduates.

Andrew commented that at Coursera, it is computer science that has the greatest student demand (with business education being the second most significant student demand). Andrew talked about the movement from supply-based education (where the classes offered are the ones that the faculty members wish to teach) towards demand-driven education (which will be based on what the students want to learn. He also noted that the state of computing pedagogy is much less mature than other STEM fields, such as physics education. Finally, Andrew commented that MOOCs are transforming the process of offering education at scale, and that this transformation will take decades to accomplish.

A lively question and answer session followed. Some of the more salient questions included:
Q) Are there any CER PhDs presently at Coursera?
A) No, but Coursera would like to hire some.

Q) What would a CER PhD do for Coursera?
A) There are huge pedagogic challenges to teaching at scale. We need to know much more about how students learn, how they study, and how we can provide much more meaningful feedback in real time to the instructor and to the students. There are several individual questions for which we'd like answers. For example, is it possible to do peer instruction at scale? Or how should we structure student learning communities?

Consider the state of computing education now, and relate it to advertising over the past 20 years. In the 1990s-2000s, there were two main advertising foci: trying to build positive brand association, and trying to get people to click on a link. The latter allowed for better data collection, and then modification based on feedback.

Q) Are there faculty members in CS departments that know enough about the learning sciences?
A) This is a challenge. It is even more of a challenge in the start-up world, where there is more of a need to move rapidly.

Q) How do you envision a CER PhD as being different from a regular CS PhD?
A) There are other interdisciplinary fields, for example computational biology. Computational biology PhD students need to develop very strong biology skills. Computing education PhDs are similar to these other interdisciplinary PhDs in this respect, of needing a significant background in a non-CS field as well as a CS background.

In later discussion, it was noted that that many CS PhD graduates do not go into academia. For example, of the 159 PhD graduates in AI in 2013, only three took tenure-track jobs at research schools. The vast majority of the remainder took industry positions.

Challenges to CER for faculty, students, departments

This breakout session had participants split across six groups, and reporting out the summary of their group discussion. The groups' discussions are summarized below:

1) Challenges for faculty
    a. Respect for the field – Since all faculty in CS teach classes, many assume they are sufficiently expert in how to teach their classes. But teaching a class does not necessarily make one a researcher in computing education. There can be a lack of respect for education as a rigorous discipline.
    b. It can be hard for a faculty advisor to find a co-advisor in education, cognitive psychology, etc. Many universities do not have a successful history of interdepartmental collaboration, especially when the departments reside in different colleges.

c. What should a PhD qualifying exam look like?
d. Getting grants to support PhD students in CER is hard. Within NSF, the CISE directorate tends to primarily fund disciplinary research, and the EHR directorate has historically not funded CER (at a level to support graduate students)

2) Challenges for PhD students
   a. Students have to obtain necessary background in multiple fields (including CS, learning, etc.). What classes should they be taking, and in what departments?
   b. Students need to learn research methods in CER
   c. Students need to be able to get jobs (and academic jobs) upon graduation
   d. Do CER PhD dissertations provide students with the "right" career trajectory?
   e. Is it better for students' "homes" to be within the computing department or the education school?
   f. How do students find their community (with other CER students)?
3) Challenges for departments
   a. CER faculty will need to be supported, as will their students. Their research will look different than traditional disciplinary research.
   b. Interdisciplinary appointments for faculty are always challenging
   c. Where should CER sit? Should there be a stand-alone department. Should it reside within the CS department (as is done with the DBER programs)? Within the school of education?

Much of the discussion focused on possible solutions to many of the challenges raised. Some of the discussion focused on graduate (or even undergraduate) students receiving a certificate or a minor in the partner department. Questions were raised as to what a minor in the learning sciences might look like for students doing a CS degree.

There was some discussion concerning the DBER model, where STEM education researchers were placed within the discipline rather than as a stand-alone department (as is often the case with engineering education programs) or within the school of education (as is commonly the case in math and science education). Discussion focused on the DBER model (with appropriate administrative support) as helping to establish rigor and value within the disciplinary department. Some concerns were raised that if the focus of computing education research was to be on K-12 computing education, it might be more appropriate to place CER at this level within a school of education.

Roy Pea reminded the group about the history of the learning sciences, as a possible model to consider for growing CER as an interdisciplinary field. In the 1960s, schools of education needed to reinvent themselves. They developed interdisciplinary programs, exploring research questions in different domains, and found researchers working on educational aspects of those fields. The learning sciences grew out of such an interdisciplinary program in the 1990s, leading today to more than 50 graduate learning science programs. Roy noted that domain matters! There is a need to develop expertise in the content area being studied. For example, questions about how novices and experts think about problems in a given area require sufficient domain expertise in the area being studied. And in response to the question as to whether learning science has influenced pre-service teachers, Roy indicated that learning science has been integrated into many of the STEM disciplines.

Important questions

Over lunch, small groups considered: What are some possible questions administrators, hiring committees, and promotion and tenure committees would like answers to, if they are to support the hiring and nurturing of computing education researchers? A partial list of questions includes the following:

Concerning PhD students:

1) What education and CS coursework/content should be required?
2) What research methods should be learned?
3) What are the seminal papers (in learning sciences and other fields) that students must read?
4) What should be the composition of the committee?
5) What are the job targets after graduation?
6) What are the most significant research questions to be pursuing?

Concerning faculty:

1) What are the "right" journals and conferences for publications? How are publications to be judged?
2) What are the relevant funding RFPs to support computing education research?
3) What are the most significant research questions to be pursuing?

Concerning departments:

1) Who are the most prominent computing education researchers? Who are the most respected? Who are producing the computing education PhD students?
2) If we had hired computing education research faculty n years ago, how would the department be better off today?
3) Will a computing education PhD know as much CS as another hire?
4) What will computing education PhDs teach if they are hired into the department?
5) Will a computing education faculty hire help make our online efforts more successful?
6) How can we change the views of existing CS faculty on the importance of education?
7) How can we justify the need for CED without implying that existing computing educators are not doing a good job?

Previous experiences with models of supporting PhD students in computing education

Mark Guzdial noted that of the six PhD students he has supported whose research was in CS education, the first two did not go on to do research in CS education after graduation, the next two have stayed involved in CS education research (one as a faculty member, and one who is currently a post-doc), one took a faculty position at a teaching college, and one will not be able to get a job in a CS department. Mark noted that the most successful PhD students had a strong CS background prior to starting their PhD in CS education.

Beth Simon noted that she has supported one postdoctoral researcher in CS education. She is currently working with one PhD student (though that student is funded through an NSF GRFP award). Beth noted that many of the courses a computing education PhD student must take in CS don't closely match the needs for a PhD in CER. She mentioned the existence of a joint PhD program between UCSD and San Diego State in STEM education, though these students need to do math or science education.

Tiffany Barnes has supported several PhD students, though none wholly in computing education. Her students have collected data from students solving problems to figure out how to build tutoring/hint systems. Students are doing CS research in support of education, and this often takes students longer to complete (as things like IRBs take longer to get approved). She has found success starting with undergraduate students who have an interest in computing education.

The discussion after the panelists spoke focused on the situations of other summit attendees. Some attendees noted that it was easier for their students to do PhDs within computing-related departments that were perhaps situated within colleges of computing or of information, but outside of computer science. In such departments, students were less likely to be given the question "What is the algorithmic contribution of your work?" as they strove to defend the significance of their dissertations.

Several attendees noted that many of the students who first approach them (the faculty) about doing PhDs in computing education do not have a strong idea about what such an endeavor typically entails. The suggestion was made to try to get more undergraduate students involved in computing education research, rather than only involving them in disciplinary CS research.

Another suggestion was made to look at HCI programs. Many HCI requirements (for graduate students) are around social studies analysis. HCI students tend not to do algorithm analysis. It seems likely that many of the skills HCI students need to develop are similar to skills computing education research students would need to develop.

There was discussion about the required expertise PhD students in computing education would need to obtain. A common view was that they would need to develop a certain amount of expertise in both computer science as well as in computing education. Some argued that it would be helpful for computing education PhD students to be good teachers. Others argued, however, that hiring CS faculty (at research schools) was generally not based on the presence of more students and the need to teach those students. Rather, it was based on improving the ranking of the department based on the quality of research it was producing. Thus, it is important for computing education to contribute research results to improve a department's ranking so that deans and provosts will want to hire computing education researchers as "regular" research faculty. A suggestion was made that perhaps the Taulbee survey could ask departments about how many faculty the department has hired who are interested in computing education.

Institutional challenges to supporting students in CS departments from doing CER

Andy Bernat identified the following challenges:

1) Research in disciplinary education is often not viewed as seriously (or viewed to be as rigorous) as disciplinary research. (This is a problem throughout STEM education, not only for CER.)
2) It can be hard to justify a computing education researcher for an open CS slot, given that many other sub-areas will have advocates among the faculty who are already in that sub-area.
3) There aren't as many long-lasting computing education funding opportunities available in computing education.
4) There are limited venues for publishing in CER.

Andy also identified possible fixes to these challenges:

1) It is important to challenge colleagues who dismiss the value of good CER. We must stand up for CER.
2) It is important for some high-profile CS programs to treat CER as "first class."
3) NSF has historically funded big efforts, and CISE has the opportunity to do so now for CER.

Susanne Hambrusch identified the following challenges:

1) CS faculty members often assume they know a great deal about CS education. But they do not understand what CER is.
2) Likewise, many education faculty members do not know much about what CS is. The differences between computer science, educational technology, and information technology may be unclear.
3) Many CS faculty members assume that computing education research means teaching introductory CS classes. CS faculty typically know little about assessment and evaluation.
4) Some departments have a history of "religious debates" regarding the

undergraduate curriculum.

5) There could be the concern that a computing education faculty member would not be able to teach upper-level undergraduate or graduate level disciplinary CS classes.

Susanne also suggested that computing education faculty candidates would need to argue how math and physics education faculty members have made their fields better as part of justifying their own work.

Lance Pérez noted that at the University of Nebraska, they are using the DBER model across the various STEM fields (thought not yet in computing education), and that the faculty members hired are thriving. These DBER faculty members have the same expectations as the regular disciplinary faculty with respect to research, support of graduate students, teaching and service. He did identify several challenges:

1) It is hard to obtain a "critical mass" with respect to the number of faculty doing research in a given STEM education field.
2) It can be challenging to support a single faculty trying to have STEM education graduate students.
3) It can be hard to "count" PhD students (though this is no different than any other interdisciplinary program).

Lance noted that it is important to have senior level administrative support/leadership. Lance is the dean of graduate studies, and an associate provost. He is very supportive of DBER. It is this level of upper administrative support that is needed at other schools.

Much of the discussion initially focused on the DBER program at the University of Nebraska (UN-L).

Q: How did the first DBER programs get created at UN-L?
A: The first hire was in biology, a department already friendly towards biology education.

Q: How does UN-L keep people from asking "How long until we start seeing educational outcomes change?"
A: Larger initiatives around STEM education will get asked this question. This hasn't (yet) been a concern for UN-L.

Q: How do you "frame" these positions on your campus? It should <u>not</u> be about improving undergraduate STEM education on campus per se.
A: Different institutions will need to handle this differently.

Later conversation focused on other challenges. One question asked what are the big computing education research problems that need addressing, and how they compare against the big research questions in other sub-areas of CS. Another concern raised was when faculty attending a job talk asked why research results from computing education haven't had an impact on how the faculty members teach. (It was noted that math and science education do have a similar problem in that few schools have adopted innovations in these fields.) Other concerns raised included the challenge of building a computing education research community, particularly among junior CER faculty. It was noted that the NSF-funded bootstrapping and scaffolding efforts did help turn CS researchers into computing education researchers, and has led to an international CER conference, ICER.

What concrete steps could/should be taken to support CER?

A determination needs to be made as to what resources are to be required. Possible resources include faculty lines, creation of a graduate program, obtaining support for post-docs, joint hires with education/cognitive psychology, etc.

Depending on the institution, there will likely be a need to convince other faculty in the CS department that CER is "real" CS.

A justification needs to be developed for faculty lines in CER. Initially, this could involve selling the idea to colleagues within CS, and then later arguing the need to administration (perhaps using "hot" topics such as research on MOOCs to convince administrators). It is important to get the support of education/cognitive psychology (or whichever department does learning science research) faculty. If other DBER faculty members exist on campus, their support should be obtained as well. It is also possible to obtain other STEM departmental support (perhaps by offering them technology/research questions they could use to do/improve online education). It was also noted that while Centers for Teaching and Learning (CTLs) do help faculty with tools and techniques, CER could complement what these CTLs already do.

There are several curricular issues involved. These include questions such as what degree students will be receiving (and whether students should obtain a dual degree in CS plus education, a minor or an MS in one of the fields while a PhD in the other, etc.), setting qualifying examinations, creating/modifying courses, and possibly creating new tracks/concentrations/programs.

There will likely need to be policy changes to support CER faculty members. These may involve how CER research is evaluated, and if joint hires are made, how to determine an equitable process for tenuring and promoting these interdisciplinary faculty. There may be opportunities to create interdisciplinary/cross-disciplinary centers to support these faculty members.

There is also a desire to consider grand visions of CER, which could have significant societal impacts. These could involve topics such as online education, broadening participation, K-12 education, and now modalities for doing instruction.

There is a need to build/grow a community of computing education researchers. This community should support cross institutional collaboration, as well as evangelizing CER.

There were also funding recommendations, including the treating of CER on an "equal footing" as CS research, larger scale funding opportunities for CER, and the support of REU sites in CER to help build the computing education background among undergraduate students.

Finally, there was some discussion as to whether the "right" name for this field is computing education research. Mark Guzdial posed the question, "Shall we rethink the name of the field?" The name "Computing education research" brands us as "education," which may not thrive in computing departments as it can be understood as teaching. Focusing on our work in the learning sciences of computing (how people come to understand computing, and how to improve that understanding) emphasizes the aspects that work within computing departments. The group had a lively discussion about possible names, though did not come to any specific conclusions in this regard.

Connections to Education, Learning Sciences and Cognitive Psychology

Aman Yadav identified several challenges in working with College of Education faculty. Many faculty members in colleges of education are not aware of the specific challenges (such as teacher preparation and assessment) computing education is facing. Most education faculty members do not have a CS background. Many CS faculty members don't have a deep understanding about pedagogic content knowledge. In general, education faculty members know a lot about how people learn, but are much less knowledgeable about the CS content. And it takes time to develop relationships.

Ken Hay noted that in Schools of Education, there is science education and math education, but the focus tends to be on K-12 teacher training. Ken identified several ways in which he considered computing education to be different from other STEM education. 1) It is the only field with an interactive formalism. 2) There are features of it being black box. And there are hierarchies of black boxes. 3) CS is incredibly explicit. (In a program, "close" is not good enough.) 4) The feedback is immediate. 5) Errors are ubiquitous. 6) There is a unique relationship between the individual and collaborative work – one can be individualistically focused, and the collaboration is distinct.

As part of a brief discussion, the observation was made that there is significant pressure in CS to teach the content vocationally. But, on the other hand, introductory CS is often able to better handle motivating students than most other STEM disciplines.

Paulo Blikstein started his remarks by recalling the title of Papert's book, "Mindstorms: Children, computers and powerful ideas." Paulo noted that people often forget about the powerful ideas. It is the powerful ideas that are important, not necessarily the children with the computers, or the jobs. Paulo then said that while revolutionary change is rare, evolutionary change is important. Today we can talk about children programming in a way we couldn't before.

A challenge Paulo faces is that disciplinary researchers often approach him with some new idea they have, and ask him to test it out. It is hard to design experiments, and disciplinary researchers are often unaware of how hard it is to create a reasonable experiment. Further, disciplinary researchers do not recognize the importance of forming a 50-50 partnership.

There was some discussion focusing on the epistemological differences between research in education and research in a STEM discipline. Some folks argued for offering summer schools for graduate students, though others felt more was needed.

Mike Horn suggested joint PhD programs (in CS and the learning sciences) as a possible way to bridge the gap. He noted that there is motivation in both directions. CS brings certain things to the table, but so do the learning sciences (such as learning theories, a discipline covering how to work with qualitative data, etc.). Mike also recommended CS consider computation in other disciplines, and what computational thinking might mean in these different fields.

Further discussion covered some of the difference types of recommendations CS researchers and education researchers make. For example, many programming language researchers may argue for teaching novice students about list comprehensions or closures. However, education researchers would likely argue that these concepts are too complex, arguing that the incremental advantage these features add may not be worth the additional cognitive load.

Hiring computing education researchers

Greg Hislop commented on job prospects for CER PhD graduates. He felt that there was likely at best only a small market in K-12, perhaps within a large school district that already had established initiatives towards including computing education within K-12 instruction. Greg believed that there are jobs in computing education/technology-based education industry. Further there are likely jobs in research labs that work in this space. He believed that there are jobs in higher education in computing departments, but that the CER researchers would need to address the issue of course coverage (i.e. what upper level CS classes could these graduates be able to teach). Further, Greg stated that it was likely larger computing departments that would have an easier time affording a CER faculty member. There are also possible options for these graduates within research centers (assuming that the center had an education focus/interest). Finally, Greg commented that these students would likely need to justify their contributions, perhaps arguing that they could improve the teaching of computing and/or improving technology use in education and/or advancing the learning sciences, as related to the domain of computing.

Mary Lou Maher offered her perspective as a department chair. She argued that it would be easier for colleges of computing to hire such graduates (where there is a more comprehensive computing program), or possibly information schools or HCI programs.

She also suggested centers for educational research, or educational innovation as possible targets. And, of course, there are companies such as Coursera and Udacity, those companies that do analytics, and educational software.

Mary Lou then challenged the summit attendees to help build a need for such hires at our own institutions. She suggested we identify goals and challenges at our institutions (such as student retention, time to graduation, diversity and collaboration) to help build the case for hiring computing education researchers. It is important to identify the needs and desires of department chairs, deans, and provosts, and how CER can connect to their interests (such as addressing many senior administrators' interests in big data). Mary Lou also suggested that we form a community, and to collaboratively help one another (perhaps creating online social networking spaces to foster communication).

Susan Rodger noted that it would be unlikely for a computing education researcher to get a regular tenure-track job in the CS department at Duke. She noted that not all traditional areas of CS (such as HCI) are covered within Duke's CS department, and that it would be hard to convince her colleagues as to the need to hire in an area where there aren't currently any researchers who are tenure-track in that area. Susan did note that a computing education researcher could get hired as a "professor of the practice." While such positions focus on teaching, they can do research, such as for computing education, write grants and support graduate students.

Murali Sitaraman noted that his school was a good place for CER, as they have a school of computing with research areas in HCI and visualization. He commented that his school views all research dollars equally, so that a computing education researcher who is successful in publishing and with obtaining grants would be well respected. He did note a concern about a lack of venues to publish computing education research results, and suggested that the community identify sub-areas of CER.

Much of the discussion focused on the places to get computing education research results published. It was noted that there are often educational tracks of larger (mainstream) conferences. Furthermore, several summit attendees thought that there were sufficient conferences at which to publish CER results.

What would be required to get a computing education researcher hired/promoted at the summit attendees' schools?

Much of the discussion in the breakout sessions focused on the different situations at the various institutions. Some schools would not hire a tenure track-faculty member in computing education, while others would. Some schools had opportunities to do joint hires (perhaps with an education school/department), while this was not possible at other schools. Some schools had teaching focused positions that allowed for research, such as professors of the practice, professors (teaching), and lecturers with security of employment. Some schools would hire in computing education within the school of education. Other schools believed they could hire in CER as part of a targeted or cluster hire (though not as part of a regular junior search). A common view was that interested faculty would need to build a business case for hiring in CER.

The discussions about promotion and tenure were lively. The challenge of not having many faculty members at top institutions to be able to write letters for promotion/tenure was noted as a problem. Some concerns were raised about the limited length of papers at SIGCSE, and the fact that ICER was not well known.

How do DBERs work, and how do we separate great research in computing education from being a great computing teacher?

Disciplinary-based education research (DBER) has been the process by which STEM education researchers are placed into the corresponding STEM department, and supported as a STEM education researcher. (See [5, 6] for more details about the term.) In general, there has been a move towards integrating science education faculty within science departments. Mathematics has been more mixed, often placing mathematics education faculty within schools of education rather than within mathematics departments (especially as much of the mathematics education research focuses on K-12). Engineering has sometimes created stand-alone engineering education departments, rather than incorporating engineering educators within the appropriate engineering department.

Diana Franklin looked at physics education research. She noted how helpful it has been to have a Nobel laureate (Carl Wieman) advocating on behalf of physics education, and suggested that it would be fantastic if a Turing award winner could do likewise for computing education. She also argued on behalf of CER, indicating that students (even at top computing programs) do not learn computing as we think they do. She argued for a manifesto that related how CER benefits CS research.

Jesse Heines explored the distinction between great computing teaching and great computing education research. He noted the importance of repeatability in order to obtain significant computing education research results.

Steve Cooper noted that while DBERs have worked in other STEM disciplines there remains the challenge of isolation (when there is only one STEM education faculty member in a STEM department. Further, there can still be the challenge of earning peer respect (unless there is strong administrative support).

Steve argued that there is a problem of conflating great computing education research with great CS teaching. Schools that have teaching-focused faculty positions (such as professors of the practice and lecturers with security of employment) tend to focus more on the faculty member's teaching than their research impact. And while it may be hard to measure "great teaching" quantitatively, the reality is that these faculty are often treated differently from the regular disciplinary faculty when being considered for promotion and tenure.

Wrap-up

There was a good deal of discussion about growing a community of computing education researchers who were supporting graduate students. This would help with mentoring the graduate students as well as the junior computing education researchers. It was observed that letter writing for tenure and promotion (and even for obtaining jobs) would be much easier if we all knew one another.

There was also a strong argument made toward creating a cohort of computing education PhD students across several institutions. This would help in strengthening the field, especially if we are able to place many of these students into academic positions.

Several folks suggested the possibility of seeking a large grant to enable the establishment of a few cohorts of PhD students in CER.

There was once again the suggestion of identifying several grand challenges in computing education. (Identifying the key research questions facing CER had been the focus of the previous workshop in January.) That said, there were several suggestions, including:

1) Educating non-computer scientists in computing
2) Educating lifelong learners in computing, taking advantage of what they already know
3) Advancing effective online education
4) Broadening participation in computing
5) Incorporating computing within and throughout K-12 education
6) Advancing new modalities of education

The summit attendees believe that the time is right to grow the community of computing education researchers supporting CER PhD students. This report can hopefully be used as a basis off of which to identify 1) the opportunities and 2) the challenges that need to be overcome as part of future efforts.

References

1) US News reports 156 US doctoral programs in computer science, as noted at: http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools/computer-science-rankings

2) The website gradschools.com identifies 242 US doctoral programs, as noted at: http://www.gradschools.com/search-programs/computer-science/doctorate/united-states

3) Wikipedia identifies 157 US doctoral programs, as noted at: https://en.wikipedia.org/wiki/List_of_academic_computer_science_departments

4) Wing, J. 2006. Computational thinking. Commun. ACM 49, 3 (March 2006), 33-35.

5) National Research Council. 2012. Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering. Washington, DC: The National Academies Press.

6) http://www.unl.edu/dber/what-dber Accessed 7/1/2014.

APPENDIX A – SUMMIT AGENDA

MONDAY	March 24, 2014	
9:00-9:15	Welcome and Overview of the Summit	Steve Cooper
9:15-10:00	Keynote Address: The Need for Computing Education PhDs in Industry	Andrew Ng
10:00-11:00	Breakout Groups (5-6 members)	
	Introduce yourself to each other (who you are, which institution you are with, and what departments you work within).	
	Describe the big challenges to making Computing Ed PhDs work at your institution.	
	For the advising of Computing Ed PhDs, what is needed for success during the PhD program, for both students and advisors?	
11:00-12:00	Report on Breakouts	
	Introduction of each group and summary of discussion points raised.	
	Whole group discussion.	
12:00-1:00	Working Lunch	
	What would administrators, admissions committees, promotion & tenure committees, and hiring committees need to know to make it possible to get more Computing Ed PhD's? What do you think they want to know about impact, research methods, research funding, hiring patterns, promotion at other institutions, and other factors?	Facilitated by Mark Guzdial (GA Tech)
1:00-2:00	Past experiences with Computing Ed PhD's and models that have worked.	
1:00	Comments by Tiffany Barnes (NCSU), Mark Guzdial (GA	

	Tech), and Beth Simon (UCSD)	
1:15	Facilitated group discussion.	
2:00-3:00	Department/School/College leaders: What are the institutional challenges to supporting students in computing departments from doing PhD research in CS Ed?	
2:00	Comments by Andy Bernat (CRA), Susanne Hambrusch (Purdue), and Lance Pérez (Nebraska)	
2:15	Facilitated group discussion.	
3:00-3:15	Break	
3:15-4:15	Breakout groups of 5-6 members: Discuss concrete steps that must be taken to support PhD level Computing Education Research	
4:15-5:00	Report on breakouts	
5:00	Break and Offsite Dinner	

TUESDAY	March 25, 2014	
9:00-10:00	Panel: How to tie in to Education, Learning Sciences, and CogSci. What are other models to be followed?	Moderated by Beth Simon (UCSD)
	Panelists: Paulo Blikstein (Stanford), Ken Hay (Indiana), Mike Horn (Northwestern), Aman Yadav (Purdue)	
9:00	Comments by panelists.	
9:25	Prepared questions for panelists.	
9:35	Facilitated group discussion.	
10:00-11:00	Panel: Targets for hiring Computing Ed PhDs. Who will hire them and how can we make that work better?	Moderated by Ann Drobnis (CRA)
	Panelists: Greg Hislop (Drexel), Mary Lou Maher (UNC Charlotte), Susan Rodger (Duke), and Murali Sitaraman	

	(Clemson)	
10:00	Comments by panelists.	
10:25	Prepared questions for panelists.	
10:35	Facilitated group discussion.	
11:00-11:15	Break	
11:15-12:15	Breakout groups of 5-6 members: What would it take to get a Computing Ed PhD hired, and promoted, at your institution? What are the models that might work for you?	
12:15-1:00	Working Lunch	
	Report on breakouts.	
1:00-2:00	How are other DBER's getting established, and how do we separate great research into Computing Ed research from being a great teacher in Computing Ed?	
1:00	Comments by Steve Cooper (Stanford), Jeff Forbes (Duke), Diana Franklin (UCSB), and Jesse Heines (UMass Lowell)	
1:20	Facilitated group discussion.	
2:00-3:00	Group Discussion: What goes in our report? What do we tell the world about the state of Computing Ed DBER? What are the next short-term and long-term steps? Who will be responsible for doing what?	
3:00-3:15	Break	
3:15-4:15	Group Discussion: What should we pitch to NSF?	

Appendix B: Summit attendees

Name	Institution
Tiffany Barnes	North Carolina State University
Andy Bernat	Computing Research Association
Paulo Blikstein	Stanford University
*Steve Cooper	Stanford University
Betsy DiSalvo	Georgia Institute of Technology
Ann Drobnis	Computing Research Association
Stephen Edwards	Virginia Polytechnic Institute and State University
***Jeff Forbes	Duke University / National Science Foundation
Diana Franklin	University of California, Santa Barbara
Christina Gardner-McCune	Clemson University
Edward Gehringer	North Carolina State University
*Mark Guzdial	Georgia Institute of Technology
**Shuchi Grover	Stanford University
Susanne Hambrusch	Purdue University
Ken Hay	Indiana University
Jesse Heines	University of Massachusetts, Lowell
Greg Hislop	Drexel University
Michael Horn	Northwestern University
Andy Ko	University of Washington
Richard Ladner	University of Washington
Celine Latulipe	University of North Carolina, Charlotte

Cynthia Lee	Stanford University
James Lester	North Carolina State University
Mary Lou Maher	University of North Carolina, Charlotte
Fred Martin	University of Massachusetts, Lowell
**Kathy Menchaca	Stanford University
Andrew Ng	Stanford University
Roy Pea	Stanford University
Lance Perez	University of Nebraska - Lincoln
**Chris Piech	Stanford University
***Jane Prey	National Science Foundation
Susan Rodger	Duke University
Mehran Sahami	Stanford University
Ben Shapiro	Tufts University
*Beth Simon	University of California, San Diego
Murali Sitaraman	Clemson University
Deborah Tatar	Virginia Polytechnic Institute and State University
Aman Yadav	Purdue University

*Summit PI
**Summit Staff
***NSF Program Officer