BUILDING AN OPERATING SYSTEM FOR

Computer Science Education

LANDSCAPE STUDY:
What is the current state of high school computer science professional development?

THIS STRAND OF WORK FOCUSED ON DESCRIBING THE current professional development opportunities that are available for high school computer science (CS) teachers. The primary data collection for this strand took place through a survey administered to providers of high school computer science teacher professional development (PD).

THE SURVEY SOUGHT TO ANSWER THE FOLLOWING QUESTIONS ABOUT HIGH SCHOOL COMPUTER SCIENCE TEACHER PROFESSIONAL DEVELOPMENT:

- WHO IS PROVIDING PROFESSIONAL DEVELOPMENT?
- WHO IS PARTICIPATING?
- WHERE, WHEN AND HOW IS THE PD HAPPENING?
- WHAT IS THE PD ABOUT?
- WHAT INSTRUCTIONAL APPROACHES DO PD PROVIDERS USE?

SUMMARY AND CONCLUSIONS
SURVEY SAMPLE, DURATION AND RESPONSE RATE

The goal of this survey was to paint as comprehensive a picture as possible of the CS PD landscape. To that end, the research team worked with a range of experts in the field of computer science education to create a list of 129 high school computer science PD providers. The list was reviewed by funders and providers of professional development and included CE21 projects (funded by NSF) and CS4HS (funded by Google) and others. The team recognized that even with a best effort to create a comprehensive list of high school computer science professional development providers some (especially local/regional) professional development experiences would be overlooked. Therefore, we made the survey link publicly available on the project web site, posted information about the survey on the SIGCSE (Special Interest Group for Computer Science Education of the Association for Computing Machinery (ACM)) list serve, a CACM (Communications of the ACM) blog post, and direct outreach with follow up phone calls. We also encouraged recipients of the survey to pass it on to others.

The survey opened on August 29th, 2012 and closed on October 15, 2012. At that point, there were 121 submitted survey responses. Of those 121, 26 cases were dropped because they contained no data, 4 cases were dropped because respondents did not consent to participate, 4 cases were dropped because the respondents indicated that they were not the appropriate person to be completing the survey, and 8 respondents were dropped because they completed less than 20% of the survey items. Three additional cases were dropped because they reported professional development occurring outside the survey timeframe (September 2011 – September 2012). The final total response rate for the survey was 76 respondents.

Of the 76 respondents, 58 came from the original list. Additionally, those 76 respondents represent 65 unique people (individuals could complete the survey for different PD experiences), 45 of which were on the original list.
WHO IS PROVIDING PROFESSIONAL DEVELOPMENT?

Most professional development was provided by institutions of higher education.

The vast majority of respondents (80%) reported their organization to be a college or university and 59% of respondents identified themselves as college/university faculty. The 20% of respondents who did not identify their organization as a college or university reported being from membership organizations, corporations, high schools, and foundations.

Providers designed and delivered their professional development with little to no involvement from local schools and/or districts.
Over two-thirds of survey respondents (67%) reported that they design and deliver their professional development with "little" (44%) to "no participation" (23%) from local schools and/or school districts.

Of those in the remaining third, nearly all respondents (29% of the total) reported that local schools or districts "set goals" and provided some support for the professional development. That support consisted primarily of help with recruitment of participants (i.e. providing names and contact information of participants, publicizing the event, and encouraging participation).

Only the remaining 3% of respondents reported that their professional development was designed, led and paid for by local schools or districts.

Google and the National Science Foundation were the primary funders of the reported computer science teacher professional development.

Google and the National Science Foundation (NSF) funded the majority of professional development experiences reported in the survey. The professional development funding sources were grouped into five categories: Google-only funded professional development (25%), NSF-only funded professional development (22%), Google plus NSF funded professional development (7%), Google plus non-NSF funded professional development (11%), NSF plus non-Google funded professional development (12%), and "All Other Funders" including state, local, and/or corporate/private funds (24%).
High school computer science teacher professional development experiences funded solely or partially by NSF have a significantly smaller percentage of in-service non-computer science teachers, compared to the Google-funded or other corporate/private funded professional development experiences. More specifically, the average percentage of participants who are in-service non-computer science teachers is 19% in NSF-funded professional development compared to 47% in Google-funded professional developments and 36% in other corporate/private funded professional developments.

Summary: Issues and Recommendations

<table>
<thead>
<tr>
<th>Issue</th>
<th>Less</th>
<th>More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevance and Fit</td>
<td>University developed professional development</td>
<td>University and school co-developed professional development</td>
</tr>
<tr>
<td>Priority</td>
<td>Higher education-driven</td>
<td>School-and district-driven</td>
</tr>
<tr>
<td>Investment</td>
<td>Externally funded professional development</td>
<td>Co-funded profession development</td>
</tr>
</tbody>
</table>

This table and the other summary tables in this report capture some of the issues that emerged from the data and offer recommendations for future goals for computer science education professional development. Note that these recommendations are framed as "Less" and "More" intentionally, recognizing that no single approach or model of professional development is a fit for every situation. Further, it is important to acknowledge that there is work to be done to move the field from "Less" to "More" and that that work will take some time. Finally, the recommendations are grounded in some of the generally accepted principles about professional development that reside in the literature. For references, see the "Resources" section of this report.
More than half of computer science PD participants were not full-time in-service computer science teachers.

More than half (51%) of the participants were not full time in-service computer science teachers. Of these, the largest group was in-service non-computer science teachers at 36%. The remaining categories of participants were "other" (11%) and pre-service teachers (5%). Of those 11% identified as "other," the top three categories included industry professionals, retired teachers and informal education providers.

Note: "In-service" refers to teachers who are currently employed as teachers. Pre-service teachers are those in teacher preparation programs not yet employed as teachers.

The most common subject taught by full-time teachers who teach computer science part-time was mathematics.
Of the in-service teacher participants who were not teaching computer science full-time, 28% on average also taught mathematics. Looking at other subjects, 16% taught science, 18% taught technology skills, 3% taught English/Humanities, 2% taught social sciences and 3% taught drafting, graphic design or another technical art.

Approximately 15% of participants were teaching another subject not listed in the menu of choices. They included business, special education, information technology, and library science.

Approximately 14% of professional development providers indicated they didn’t know what other subjects the participants taught.

Three-quarters of the professional development providers had some participants who were new to computer science.

Seventy-five percent of the professional development providers reported having participants that were identified as new to computer science. In those that reported having participants new to computer science, the proportion of those teachers ranged widely from 2% to 100% for an overall average of 51%. 30% (N=23) of the professional development providers reported that over half of their participants were new to computer science. In eight of the 76 professional development experiences 100% of participants were new to computer science.
Most PD experiences served relatively small numbers of participants

*Total does not equal 100% due to rounding
Seventy-three percent of all professional development providers reported having 40 or fewer participants. More specifically, nearly one quarter (23%) reported serving 0-10 participants and another quarter (23%) reported serving 11-20 participants. Thus, nearly half (46%) of all reported professional development experiences serve 20 or fewer participants. Another 15% reported serving 21-30 participants and 12% reported serving 31-40 participants to comprise the 73% that serve 40 or fewer.

The remaining 27% of professional development experiences report a range of larger participant numbers. More specifically, 3% of professional development experiences reported 41-50 participants, 4% reported 51-60 participants, 3% reported 61-70 participants, 4% reported 71-80 participants, and 14% reported having more than 100 participants.

### Summary: Issues and Recommendations

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<thead>
<tr>
<th>Issue</th>
<th>Less</th>
<th>More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Size</td>
<td>---</td>
<td>Relatively small numbers of participants</td>
</tr>
<tr>
<td>Audience</td>
<td>Mixed groups</td>
<td>Homogeneous groups</td>
</tr>
</tbody>
</table>

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WHERE, WHEN AND HOW IS THE PD HAPPENING?

Over two-thirds of professional development experiences reported "teacher self-selection" for participant recruitment.

Sixty-eight percent of professional development providers reported their application process to consist of teacher self-selection. About a third, (32%) reported that they were "selective" in that they targeted specific teachers based on qualifications and/or experience and 16% reported that they were selective in that they targeted particular geographic areas. Only 8% of respondents reported their professional development experience was non-selective and included all computer science teachers within a school or school district. Note that for this question, respondents were able to select more than one option to describe their selection criteria but few did.

Local teacher networks were identified as the most common way of publicizing computer science teacher professional development opportunities.

- 83% Local Teacher Networks
- 49% Computer Science Teachers Association (CSTA)
- 33% School District Newsletters or Websites
A large majority of professional development providers (83%) reported using local teacher networks to publicize information about the computer science professional development experience. The next most common means providers identified was CSTA (49%) and school district newsletters or websites (33%). Sixty-four percent of providers chose “other.” The survey did not provide an opportunity for explanation of “other” on this item.

Most participants attended professional development close to home.

Professional development experiences were predominately comprised of local teachers (58%). The remaining 42% of participants taught regionally (11%), taught in another region within the state (16%) and/or taught in another state (7%). The results were similar for in-person professional development as well as professional development that was partially or mostly online.

45% of computer science professional development experiences paid participants to attend.

Forty-five percent of the high school computer science professional development experiences paid participants to attend and complete the experience, while 55% did not.
41% of computer science professional development experience offered credits for participation.

Forty-one percent of high school computer science professional development experiences offered credits of varying kinds for attending and completing the professional development experience. In turn, 59% did not. Of those that did offer academic credit to participants, about half (52%) offered continuing education credit, about a third (32%) offered graduate credit, 3% offered undergraduate credits, and 13% offered other forms of credit including clock hours and community college credit.

80% of computer science professional development experiences offered participants material incentives.
Eighty percent of respondents reported that they provided participants with "other" kinds of incentives (not money or credits) or support when they attended and completed the professional development experience. These incentives included classroom materials (textbooks, lesson plans, handouts and worksheets, LEGO® robotics kits) and technology (laptops, software, jump drives).

The vast majority of PD providers reported having in-person PD experiences, and a little under half reported that their experiences included an online component.

Nearly all (95%) of the computer science professional development providers reported including in-person experiences for participants. Forty-one percent of computer science professional development providers reported their experience included an online component, while 59% did not.

89% of providers offered PD through a summer workshop. Of these, 44% offered follow up of some kind; 46% offered no post-workshop follow up.

Of the respondents who reported doing an "in person summer workshop" with follow up, the two most common kinds of follow up were "in person meeting only" (28%) and "in person meeting" with phone calls, online meetings and mail (28%). The next most common kind of follow up was "mail only" (17%).
### Summary: Issues and Recommendations

<table>
<thead>
<tr>
<th>Issue</th>
<th>Less</th>
<th>More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruitment</td>
<td>Casting a broad net for participants in PD experiences</td>
<td>Targeting participants and audience for PD experiences</td>
</tr>
<tr>
<td>Exposure and Dosage</td>
<td>Single opportunities with little follow up</td>
<td>Continuing exposure to professional development experiences for the more hours over longer periods of time</td>
</tr>
<tr>
<td>Isolation</td>
<td>Professional development out of school</td>
<td>School based and/or job-embedded professional development</td>
</tr>
<tr>
<td>Unreached</td>
<td>---</td>
<td>Providing opportunities where they don't already exist</td>
</tr>
</tbody>
</table>

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Just over half of the professional development providers reported a focus on preparing teachers to teach a particular course.

A little more than half (54%) of the professional development providers reported that they focus on preparing teachers to teach a particular course (i.e. AP Computer Science Principles, AP Computer Science A, Exploring Computer Science, and Computer Applications (e.g. Microsoft Office)), while the remainder (46%) of respondents report that their professional development experience is not preparing participants to teach a particular course.

About two-thirds of professional development providers who reported they prepared participants for a particular course spent the majority of their professional development time on that course.

Just over half (54%) of PD experiences spent at least three-quarters of their PD time preparing teachers to teach a particular course.

About 2/3 of the 54% percent of respondents who indicated that they focus some of their professional development time on preparing participants to teach a particular course reported spending a significant majority (at least ¾) of professional development time on that course.

More specifically, 17% reported devoting 75% or more of its PD time to prepare teachers to teach AP Computer Science Principles; another 15% reported devoting 75% or more of PD time to prepare teachers to teach Exploring Computer Science; another 15% reported devoting 75% or more of PD time to preparing teachers to teach AP Computer Science A; and another 17% reported preparing teachers to teach other courses not listed. This comes to 64% of those who report preparing participants for a particular course. No respondents indicated that they devoted at least 75% or more of time to Computer Applications.

A little over a third (36%) of respondents who said they focused some amount of their professional development on a particular course devoted less than 75% of their PD time on any single course.
Participants of PD designed for a course were more likely to intend to teach the course.

**Average Number of Participants Committed to Course**

<table>
<thead>
<tr>
<th>Course</th>
<th>Intention (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploring Computer Science</td>
<td>61%</td>
</tr>
<tr>
<td>AP Computer Science Principles</td>
<td>47%</td>
</tr>
<tr>
<td>AP Computer Science A</td>
<td>78%</td>
</tr>
</tbody>
</table>

| Range            | 0 - 100% | 0 - 100% | 10 - 100% |

The respondents who devoted more than 75% of time to preparing teachers to teach AP Computer Science Principles reported an average of 47% of their participants intending to teach that course with the range being from 0% of the participants to 100% of participants.

The respondents who devoted more than 75% of time to preparing teachers to teach Exploring Computer Science (ECS) reported an average of 61% of their participants intending to teach the course with the range being from 0% of participants to 100% of participants.

The respondents who devoted more than 75% of time to preparing teachers to teach AP Computer Science A (15%) reported an average of 78% of their participants intending to teach the course with the range being from 10% to 100% of participants.

The primary goals of PD experiences most often chosen by respondents were: 1) participants' abilities to increase student participation and engagement in computer science; 2) participants' understanding of particular computer science concepts; and 3) participants' abilities to implement particular pedagogical approaches or strategies for teaching computer science concepts.

The three goals most frequently ranked number one by providers were "participants’ abilities to increase student participation and engagement in computer science" (N=22; 29%), "participants’ understanding of particular computer science concepts" (N=19; 25%), and "participants abilities to implement particular pedagogical approaches or strategies for teaching computer science concepts" (N=18; 24%).

"Learning a particular programming tool" and "learning a particular programming language" were not selected by any of the providers as a number 1 goal. "Learn a particular programming tool" was
selected by only 10 providers as a top three goal. Similarly, no provider selected "learn a particular programming language" as a number one goal, and only four ranked it as a top three goal.

<table>
<thead>
<tr>
<th>PD Goal</th>
<th>Top 1</th>
<th></th>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Participants abilities to implement increase student participation and engagement in computer science</td>
<td>22</td>
<td>29%</td>
<td></td>
<td>57</td>
<td>75%</td>
<td></td>
</tr>
<tr>
<td>Participants' understanding of particular computer science concepts</td>
<td>19</td>
<td>25%</td>
<td></td>
<td>43</td>
<td>57%</td>
<td></td>
</tr>
<tr>
<td>Participants abilities to implement particular pedagogical approaches or strategies for teaching computer science concepts</td>
<td>18</td>
<td>24%</td>
<td></td>
<td>49</td>
<td>64%</td>
<td></td>
</tr>
<tr>
<td>Participants' abilities to address issues of access, equity and diversity in computer science</td>
<td>4</td>
<td>5%</td>
<td></td>
<td>20</td>
<td>26%</td>
<td></td>
</tr>
<tr>
<td>Participants' abilities to reflect on and thus improve their own teaching practice</td>
<td>4</td>
<td>5%</td>
<td></td>
<td>18</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td>Development of a professional learning community</td>
<td>4</td>
<td>5%</td>
<td></td>
<td>16</td>
<td>21%</td>
<td></td>
</tr>
<tr>
<td>Learn a particular programming tool</td>
<td>0</td>
<td>0%</td>
<td></td>
<td>10</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Learn a particular programming language</td>
<td>0</td>
<td>0%</td>
<td></td>
<td>4</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Other 1</td>
<td>4</td>
<td>5%</td>
<td></td>
<td>7</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>Other 2</td>
<td>1</td>
<td>1%</td>
<td></td>
<td>4</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>
The three most commonly reported computer science content areas were: 1) programming concepts; 2) computational thinking and problem solving practices; and 3) programming tools and languages. The amount of time devoted to these areas varied greatly across professional development experiences.

The three most frequently identified content of professional development experiences was programming concepts (86% of all respondents), computational thinking and problem solving practices (79%), and programming tools and languages (74%).

The proportion of time spent on each of these content areas, however, varied widely. Respondents reported spending anywhere from 5% of time to 100% of time on programming concepts, with an average of 30% of professional development time spent. Similarly, respondents reported spending anywhere from 4% to 95% of time on computational thinking and problem solving practices for an average of 25% of time spent. And programming tools and languages comprised, on average, 24% of time with a range from 3% to 90%.

By contrast, connecting computing with other disciplines comprised, on average, 16% of time, modeling and simulation concepts and tools comprised 15% of time, computing and society and/or social impacts of computing comprised 14% of time and using/manipulating data comprised 10% of time.

Of those that reported “other computer science content” in their professional development, the top two answers were robotics, and computer/network/history basics.
For the three goals most ranked number one by providers, those same providers reported spending most of the time devoted to computer science content to: 1) programming concepts; 2) computational thinking and problem solving practices; and 3) programming tools and languages.

For the three goals most frequently ranked number one, the content emphasized was predominately programming concepts, computational thinking and problem solving practices, and programming tools and languages.

It is noteworthy that there isn’t a great deal of difference in content emphasis between the three groups choosing each of the different number one goals. Further, even though no respondents chose "learning a particular programming language" or "learn a particular programming tool" as a number 1 goal, "programming tools and languages" was one of the top three content areas respondents reported spending time on. It is unclear how programming tools and languages were emphasized in that professional development and/or the extent to which they may have been vehicles for focusing on other content areas.

Three pedagogical content areas were selected by at least half of the respondents. They were: 1) assessing student learning; 2) materials and/or technology management; and 3) facilitating discussion. As with computer science content, the amount of time devoted to these areas varied greatly across professional development experiences.

The survey provided 17 options for pedagogical content focus areas. Of these, 54% of respondents selected assessing student learning, 51% of respondents selected materials and/or technology management, and 50% of respondents selected facilitating discussion. The range of time devoted to these, however, as with many of the content areas, was highly variable.

It is noteworthy that well over a third of respondents selected "other" pedagogical content and of those respondents, they reported spending over 2/3 of their time on that "other" content. When
looking at their descriptions of "other" almost half (45%) of them began their answer with "how to..." (e.g. "how to teach Java") but didn't offer any more specific pedagogical strategies.

Further, another five respondents who selected "other" cited broad terms such as "STEM learning strategies," "inquiry" or "active learning" and another six of respondents selecting the "other" category reported that they don't teach any pedagogy in their professional development experience.

For the three goals most frequently ranked number one by providers, there was high variation in the pedagogical content taught.

For those respondents who identified "participants abilities to increase student participation and engagement in computer science" as a top goal, they reported spending 18% of their time on materials and/or technology management, 18% of their time on "other," 13% of their time on facilitating discussion and 10% on writing lessons. The other percentages were under 10%.

In contrast, for those who identified "participants' understanding of particular computer science concepts as a number one goal, 43% of time was spent on "other" while only assessing student learning (14%) and materials and/or technology management (11%) were reported at over 10% of time.

64% of respondents identified "participants abilities to implement particular pedagogical approaches or strategies for teaching computer science concepts" as a top three goal. They reported that they spent most of their time, on average, on "other" pedagogical content. The next highest focus areas were, on average, writing lessons, sequencing lessons, materials and/or technology management, and facilitating discussion.
Professional development structure, goals and content varied widely regardless of professional development size (numbers of participants).

Professional development experiences that had 20 participants or fewer did not have different goals, structure or content than professional development experiences designed for those that had 100 participants or more. There was no significant relationship between the size of PDs and their structure, goals and content.

Equity and issues of access and diversity appeared to be important to respondents.

"Participants' abilities to address issues of access, equity and diversity in computer science," was ranked as a number one goal by 5% of survey respondents, and as a top three goal by 26% of providers. Though not a highly ranked as a top three choices, this goal of equity, access and
diversity was dominant as a 4th place and 5th place ranking.

Further, although addressing issues of access, equity and diversity in computer science was not listed as an option in the "computer science content" item, six respondents wrote it in as an "other" content covered during their professional development experience.

Summary: Issues and Recommendations

<table>
<thead>
<tr>
<th>Issue</th>
<th>Less</th>
<th>More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fit</td>
<td>Widely varied disciplinary content within and across PD experiences</td>
<td>Disciplinary content aligned to goals and target audience within PD experiences</td>
</tr>
<tr>
<td>Fit</td>
<td>Widely varied pedagogical content within and across PD experiences</td>
<td>Pedagogical content aligned to goals and target audience within PD experiences</td>
</tr>
<tr>
<td>Pedagogical Understanding</td>
<td>Vaguely defined pedagogical content.</td>
<td>Clarified pedagogical strategies and specified classroom applications</td>
</tr>
<tr>
<td>Classroom Application</td>
<td>Isolated content and approaches</td>
<td>Content and pedagogy directly tied to teacher's instructional goals, curricular frameworks and/or courses</td>
</tr>
<tr>
<td>Underrepresented</td>
<td>---</td>
<td>Attention to increasing access and equity</td>
</tr>
</tbody>
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Most of the respondents (87%) reported using two main instructional approaches: 1) whole group lecture and/or presentation; and 2) self-directed and/or PD leader guided individual or small group hands-on computer work. However, self-directed and/or PD leader guided individual hands-on computer work comprised the largest percentage of reported professional development experience time on average.

Of the 66 respondents reporting the use of whole group lecture and/or presentation, only 5 respondents reported spending more than 50% time in the whole group lecture and/or presentation format. In contrast, 21 respondents (about 25%) of those reporting that they used self-directed and/or PD leader guided individual or small group hands-on computer work reported spending 50% or more of their time doing “individual or small group projects using computers.”
Professional development delivery formats varied across a range of professional development goals.

Of the few (5) respondents who reported spending 50% or more of their time in whole group lecture and/or presentation format, two ranked "participants' understanding of particular computer science concepts" as the highest priority goal, and two others selected "development of a professional learning community." One selected "participants' abilities to address issues of access, equity and diversity in computer science."

On the other hand, of the 21 respondents (about 25%) who reported spending 50% or more time doing "individual or small group project using computers" 43% ranked "participants' understanding of particular computer science concepts" as the highest priority goal; about one-quarter (24%) selected "participants' abilities to increase student participation and engagement in computer science"; and 19% selected "participants’ abilities to implement particular pedagogical approaches or strategies for teaching computer science concepts."

Finally, only 4 respondents reported spending 50% or more of their time doing "individual or small group projects without using computers." For these respondents, two ranked "Participants’ abilities to increase student participation and engagement in computer science" as the top 1 goal; one selected "participants' abilities to implement particular pedagogical approaches or strategies for teaching computer science concepts," and the other selected "other" as its top goal.

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<tr>
<td>Educating Teachers</td>
<td>---</td>
<td>Opportunities for teacher reflection</td>
</tr>
<tr>
<td>Educating Teachers</td>
<td>---</td>
<td>Small group discussion</td>
</tr>
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The survey yielded a rich, wide ranging set of findings. However, when considered together, those findings lead to three main conclusions:

As a field, computer science education professional development needs to move toward more coherence.

As a field, computer science education professional development needs to move toward better fitting the needs of the groups that will comprise the computer science teacher workforce.

As a field, computer science education professional development needs to focus more on teaching and learning in the classroom.

This table synthesizes all of the summary tables in this report. It communicates some of the issues that emerged from the data and offers recommendations for future goals for computer science education professional development. As with the other tables in this report, note that these recommendations are framed as "Less" and "More" intentionally, recognizing that no single approach or model of professional development is a fit for every situation. Further, it is important to acknowledge that there is work to be done to move the field from "Less" to "More" and that that work will take some time. Finally, the recommendations are grounded in some of the generally accepted principles about professional development that reside in the literature. For references, see the "Resources" section of this report.
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</tr>
</thead>
<tbody>
<tr>
<td>Relevance and Fit</td>
<td>University developed professional development</td>
<td>University and school co-developed professional development</td>
</tr>
<tr>
<td>Priority</td>
<td>Higher education driven</td>
<td>School and district driven</td>
</tr>
<tr>
<td>Investment</td>
<td>Externally funded professional development</td>
<td>Co-funded professional development</td>
</tr>
<tr>
<td>Class Size</td>
<td>---</td>
<td>Relatively small numbers of participants</td>
</tr>
<tr>
<td>Audience</td>
<td>Heterogeneous groups</td>
<td>Homogenous groups</td>
</tr>
<tr>
<td>Recruitment</td>
<td>Casting a broad net for participants in PD experiences</td>
<td>Targeting participants and audience for PD experiences</td>
</tr>
<tr>
<td>Exposure and Dosage</td>
<td>Single opportunities with little follow-up</td>
<td>Continuing exposure to professional development experiences for more hours over longer periods of time</td>
</tr>
<tr>
<td>Isolation</td>
<td>Professional development out of school</td>
<td>School based and/or job-embedded professional development</td>
</tr>
<tr>
<td>Unreached</td>
<td>---</td>
<td>Providing opportunities when they don’t already exist</td>
</tr>
<tr>
<td>Fit</td>
<td>Widely varied disciplinary and pedagogical content</td>
<td>Disciplinary and pedagogical content aligned to goals and target audience</td>
</tr>
<tr>
<td>Pedagogical Understanding</td>
<td>Vaguely defined pedagogical content</td>
<td>Clarified pedagogical strategies and specified classroom applications</td>
</tr>
<tr>
<td>Classroom Application</td>
<td>Isolated content and approaches</td>
<td>Content and pedagogy directly tied to teachers’ instructional goals, curricular frameworks and/or courses</td>
</tr>
<tr>
<td>Underrepresented</td>
<td>---</td>
<td>Explicit attention to increasing access and equity</td>
</tr>
<tr>
<td>Educating Teachers</td>
<td>---</td>
<td>Opportunities for small group discussion and reflection</td>
</tr>
</tbody>
</table>
Resources for Professional Development

Education Week

Learning Forward

Designing Professional Development That Works.

Supporting quality staff development with best practices aligned policies.
Edwin Church, Paul Bland, and Bret Church

Teacher Learning: What Matters?
Linda Darling-Hammond and Nikole Richardson

Professional Learning in the Learning Profession: A Status Report on Teacher Development in the United States and Abroad
Linda Darling-Hammond, Ruth Chung Wei, Aletha Andree, Nikole Richardson, and Stelios Orphanos

Effects of Professional Development on Teachers' Instruction: Results from a Three-Year Longitudinal Study
Laura M. Desimone, Andrew C. Porter, Michael S. Garet, Kwang Suk Yoon, and Beatrice F. Birman

What Works in Professional Development?
Thomas R. Guskey and Kwang Suk Yoon

Learning Mathematics for Teaching: Results from California's Mathematics Professional Development Institutes
Heather C. Hill and Deborah Loewenberg Ball

Building a Learning Community: A Tale of Two Schools
Ban Mindich and Ann Leiberman

A Cost Framework for Professional Development
Allan Odden, Sarah Archibald, Mark Fermanich and H. Alix Gallagher

Reviewing the evidence on how teacher professional development affects student achievement
Kwang Suk Yoon, Teresa Duncan, Silvia Wen-Yu Lee, Beth Scarloss, Kathy L. Shapley

Teacher Learning and the Acquisition of Professional Knowledge: An Examination of Research on Contemporary Professional Development
Suzanne M. Wilson and Jennifer Berne

Exemplary Science: Best Practices in Professional Development
Robert E. Yager
Under the direction of the Association for Computing Machinery (ACM), in partnership with the Computer Science Teachers Association, Google, Microsoft, the National Center for Woman and Information Technology, and the National Science Foundation.

**Funding provided by Google**