LittleFe/BCCD Project

Report on the LittleFe Evaluation Survey

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Introduction

The LittleFe/BCCD group received support from NSF grants 1258604 and 1347089 to host "Buildout" sessions as part of the HPC Educators Program at the Supercomputing Conferences SC12 and SC13. Buildout sessions are one-, two-, or three-day activities where teams, each with faculty members and possibly their students from colleges and universities across the United States, spend the allotted time assembling their LittleFe cluster, installing the Bootable Cluster CD (BCCD) Linux distribution, and learning how to use and develop curriculum modules for the LittleFe/BCCD platform. NSF grant 1258604 also provided a modest amount of support to evaluate the success of the LittleFe Buildout sessions.

The project evaluation has two overall goals: (1) to assess the quality of the LittleFe/BCCD platform as a tool for teaching and learning parallel/distributed computing and computational science in general; and (2) to understand how we can improve the platform and make it more available and accessible to a broader audience. Because of time and budget constraints of the project, the main tools used for completing the project evaluation were online surveys. One set of surveys targeted faculty and students who participated in the SC12 and SC13 LittleFe Buildouts and who took the units they assembled back to their home institutions. A separate evaluation survey addressed the use of LittleFe/BCCD at those institutions, which includes the creation of new curriculum modules for the LittleFe/BCCD platform. This latter survey also targeted participants of other LittleFe Buildout events besides those at SC12 and SC13. Parallel with the surveys, the LittleFe/BCCD team collected reports from Buildout participants via Google Forms on their publication and outreach activities that involved the LittleFe/BCCD units.

This brief report summarizes the results from the LittleFe Evaluation survey. Other reports discuss the results of the SC12 LittleFe Buildout Survey [1] and the SC13 LittleFe Buildout Survey [2]. In this report, we first discuss the development of the survey and the methodology through which it was deployed. The next section summarizes both the quantitative and qualitative results and offers some brief conclusions. The final section discusses next steps in the project evaluation. The Appendix contains the survey instrument itself.

Methods

The five groups of faculty and students who participated in LittleFe Buildout events from 2011 through 2014 were sent the LittleFe Evaluation Survey in October 2013. This survey was developed to assess these participants' use of LittleFe/BCCD in their teaching, research, and outreach, as well as their use and development of curriculum modules used to teach students about HPC and parallel computing concepts.

The LittleFe Evaluation Survey gathered information on the usage of LittleFe/BCCD in curricula and classroom teaching, as well as the use and development of LittleFe curriculum modules. The survey was comprised of 35 multiple-choice and free-text response questions divided into 4 sections, which addressed demographics and background information, use of existing curriculum modules, creation of new curriculum modules, and use of LittleFe/BCCD

for learning, teaching, and research. (See Appendix for a complete list of all survey question pages).

The survey was implemented using a web-based survey tool provided by the National Computational Science Institute (NCSI). A survey link was emailed to the 2011 Buildout participants on October 4, 2013. A second email was sent on October 15. A third email was sent on November 4 to the participants who had not yet taken the survey. A survey link was emailed to the 2012 Buildout participants on January 2, 2014. A second email was sent on January 15. Between February and December 2014, the survey was deployed to the 2013 Buildout participants, and numerous additional emails were sent to the participants who had not yet taken the survey. In December 2014, the survey analysis began.

Results

Of the 56 institutions whose faculty and students participated in Buildout workshops from 2011-2014, 43 had at least 1 faculty member finish the online survey. This means almost 77% of the institutions that participated in Buildout workshops completed the survey. Of the 107 total Buildout participants asked to participate in the evaluation survey, 57 participants took the survey. This means 53% of the individuals who participated in Buildout workshops completed the survey.

Background and Demographics

Table 1 through Table 5 summarize the demographic characteristics of participants for the survey. A relatively small percentage of the participants were female (10/55 or 17.5%). Similarly, a relatively small percentage were non-white (20/57 or 35%).

Gender	
Female	10
Male	45
No response	2

Table 1. Gender of LittleFe Evaluation Survey Participants

Ethnicity	
White, non-Hispanic	35
Black, non-Hispanic	3
Asian	10
Hispanic	7
Native Hawaiian or Pacific Islander	0
American Indian or Alaskan Native	0
More than 1 Race: non-Hispanic	0
More than 1 Race: Hispanic	0
No response	2

Table 2. Ethnicity of LittleFe Evaluation Survey Participants

Table 3 shows that the large majority of participants in the survey were faculty at 4-year colleges. A number of participants who marked "Other" were at combined 4-year and M.S. or Ph.D. granting institutions. The "Other" group also consisted of staff and management.

Institution Type	
K-12, Pre-college	1
2-year college	2
4-year undergraduate	39
Ph.D. granting	5
I do not teach (I am currently a student)	4
Other	6

Table 3. Institution Type of LittleFe Evaluation Survey Participants

Table 4 shows that the LittleFe Buildouts catered to teachers with a range of experience. The most common amount of teaching experience was 5 years or fewer (16/53, or about 30%), and only slightly less common was 20 years or more (12/53, or about 23%).

Years Teaching	
0-5	16
6-10	10
11-15	9
16-20	6
Greater than 20	12

Table 4. Years Teaching of LittleFe Evaluation Survey Participants

Table 5 shows the number of participants in the survey from each Buildout workshop. Of the two participants who marked "None", one was scheduled to attend the SC13 Buildout but did not attend, and one was involved with a different Buildout than SC11 in 2011, which was not available as an option to select. A number of participants who marked SC11 as their Buildout had actually participated in a different Buildout in 2011, and no effort was made in this analysis to distinguish these participants.

LittleFe Buildout Attended	
2011 Seattle, Washington - SC11 Education Program	17
2012 Salt Lake City - SC12 HPC Educators Program	17
2013 Denver - SIGCSE 2013 Conference	8
2013 Denver - SC13 HPC Educators Program	13
None	2

Table 5. Buildouts Attended by LittleFe Evaluation Survey Participants

II. Using Curriculum Modules with LittleFe/BCCD

Table 6 shows that existing LittleFe/BCCD curriculum modules scored highly in terms of usefulness and coverage of key topics. As one can see, 41 of the 57 participants (72%) marked either Strongly Agree or Somewhat Agree for usefulness, and 42 of the 57 participants (74%) marked either Strongly Agree or Somewhat Agree for coverage of key topics. Only 1 participant marked Somewhat Disagree in each of the questions, and no participants marked Disagree. Interestingly, 11 participants marked N/A for each of the two questions, and this may be explained by the responses to the short-answer questions, which are discussed below.

	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	N/A	N
Overall I think the existing LittleFe curriculum modules are useful for teaching about parallel programming and computational science.	22	19	4	1	0	11	57
Overall I think the existing LittleFe curriculum modules cover key topics in parallel programming and computational science.	25	17	3	1	0	11	57

Table 6. Experiences Using Curriculum Modules with LittleFe/BCCD

Short-Answer Responses.

For each free-text short-answer question, all responses by participants were reviewed and the main themes or suggestions were summarized. The summaries are listed and discussed below.

Responses to the first short-answer question (A, see the text box in the right margin) indicated that many participants used existing modules in classes, work, and/or research. Some participants were unable to find the existing modules, and some were aware of the modules but chose not to use them. The modules most often mentioned in this first question were GalaxSee (n-body physics, mentioned 14 times), Area Under a Curve (numerical integration, mentioned 11 times), and MPI Hello World (simple message-passing parallelism, mentioned 10 times).

Responses to the second short-answer question (B, see the text box below) indicated that many participants wanted the modules to be easier to find, have better documentation, cover a wider range of topics (particularly at the introductory level), include more curriculum design elements, and have a standard, template form.

A. What LittleFe/BCCD curriculum modules have you used or are you planning to use? Please name the modules and describe the types of use using the following types or levels of experience. We distinguish several types of use or levels of experience with a module. As appropriate, you can choose more than one type of use:

- **Don't know - I have never used the module but am planning to at some point**
- **Know somewhat - I have used the module but not extensively**
- **Know well - I have used the module extensively**
- **Demonstrated - I have used the module and demonstrated it to students in classes or outside of classes**
- **Integrated - I have used the module and integrated the use of it into one or more of my courses**
- **Work or research - I have used the module in my own work or research**

Module name (# of mentions)
- GalaxSee (14)
- Area Under a Curve (11)
- MPI Hello World (10)
- Conway's Game of Life (7)
- CUDA Hello World (7)
- Sieve of Eratosthenes (4)
- Pandemic (3)
- non-BCCD modules (3)
- Binary Tree Traversal (1)
- Parameter Space (1)
- NW Missouri State's Operating System Labs (1)

B. What could be done to improve the existing LittleFe/BCCD curriculum modules and their coverage?
- More applications in different STEM fields
- Make it easier for users unfamiliar with Linux to use the modules
- Have an online forum for sharing of ideas
- Use an integrated general framework so modules can be categorized by levels, concepts to be taught, and sequence
- Publish them in a place that can be easily found with a Google search
- Provide more materials geared towards novice students
- Provide a more extensive repository on the web
- Regularly update the modules
- Evaluate learning outcomes by including pre and post tests
- Provide additional training sessions on using them
- Provide additional exercises that students can do on their own
- Provide an expected duration for each module
- Provide short documentation for more of the modules

III. Creating Curriculum Modules for LittleFe/BCCD

Table 7 shows that a total of 84 curriculum modules are under planning or development by the 43 institutions that participated in the survey. The majority of these modules (52 of 84, or 62%) have not yet seen classroom use, but 32 have, and 10 of these have already been submitted back to the LittleFe team. This falls short of the LittleFe team's expectations that each participating institution would provide at least one module within one year of owning the LittleFe. The responses to the short-answer questions provide a few possible explanations for this result.

Module Milestones	
Planning	28
Implementing	24
Completed	16
Integrated	6
Submitted	10

Table 7. Curriculum Module Milestones

The responses in Table 8 are slightly less favorable than those in Table 5, which would seem to indicate that while modules were useful in classes, they did not necessarily serve as helpful examples for creating new ones. This is supported by responses to the short-answer questions. Still, the most common answer to the questions in Table 8 was

Strongly Agree. The table shows that 21 of 57 participants (37%) agreed strongly that existing curriculum modules were helpful for creating new ones, and 15 of 57 (26%) agreed strongly that instructions given during the Buildout workshops was helpful for creating new modules. Again, the responses to the short-answer questions shed light on the lower scores.

	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	N/A	N
The existing curriculum modules were helpful in creating new ones.	21	13	8	1	1	13	57
The instruction and support I got during and after the LitteFe/BCCD Buildout workshop were helpful in creating new modules.	15	12	13	6	1	10	57

Table 8. Helpfulness of existing modules and instruction/support

Short-Answer Response.

Many participants who answered this short-answer question (C, see the text box in the right margin) indicated that the existing modules were hard to find and/or that instruction received at the workshop was inadequate for creating new modules. Many recommendations were similar to those mentioned in a previous question (B, see above), which would seem to indicate that following the suggestions to improve the quality of existing modules would make it easier for participants to create new modules as well. Devoting more time to modules during the Buildout workshops would also likely have a positive effect.

C. What could be done to improve the creation of LittleFe/BCCD curriculum modules?
- Make existing ones easier to find
- Provide more instruction on how to create them
- Have more examples available, in a centralized location
- Spend more time covering it during the Buildout workshop
- Provide short video tutorials
- Provide more reminders via the mailing list

IV. Using LittleFe/BCCD for Learning, Teaching and Research

Short-Answer Response.
The overwhelming majority of courses mentioned in response to this question (D) were computer science courses. However, courses in mathematics, engineering, and physics were also represented. This question was responded to by 53 of the 57 participants.

D. In what courses are you now using or planning to use your LittleFe/BCCD unit?
Course subjects (# of courses mentioned):
- Computer science (64)
- Mathematics (6)
- Physics (6)
- Computer engineering (6)
- Engineering (5)
- None (5)
- Electrical engineering (4)
- Computer information systems (2)
- Astrophysics (1)
- Statistics (1)

Table 9 shows responses for the types of modules being used or planned for being used in courses. The most commonly selected response was that both existing modules and "participant-created" modules were being used with the LittleFe/BCCD unit. There were 9 participants who did not respond to this question, which may indicate that these participants are not using the LittleFe/BCCD unit in classes. Because 43 respondents said they used or planned to use modules they created, it is evident that new LittleFe/BCCD modules are being developed by Buildout participants.

If you are now using or planning to use your LittleFe/BCCD unit in courses, which modules are you are using or planning to use?	
Only existing modules	4
Modules I created	16
Both types	27
Neither type	1
No response	9

Table 9: Usage of modules in courses

Short-Answer Question.
The most frequent category of modules listed in response to this question (E) were ones not already found on the BCCD. GalaxSee and Area Under a Curve were both mentioned frequently, which is consistent with responses to question A.

E. If you are now using or planning to use your LittleFe/BCCD unit in courses, please name the modules you are using or planning to use.
Module name (# of times mentioned)
- New/non-BCCD modules (32)
- GalaxSee (12)
- Area Under a Curve (9)
- Conway's Game of Life (7)
- MPI Hello World (7)
- CUDA Hello World (6)
- None (6)
- Sieve of Eratosthenes (3)
- Binary Tree Traversal (3)

Only 38 of the 57 survey participants answered both of the questions in Table 10. This is only 67% of the participants. Those who did answer had very positive responses, with no one ranking their experiences as Poor or Very Poor.

	Very Good	Good	Satisfactory	Poor	Very Poor	N
If you are now using your LittleFe/BCCD unit in courses, what is your overall assessment of student learning and interest so far?	19	13	7	0	0	39
If you are now using your LittleFe/BCCD unit in courses, what is your overall assessment of your own experiences so far?	15	14	9	0	0	38

Table 10: Student and instructor experience using LittleFe/BCCD

Exactly half of the participants who answered the question in Table 11 said that they were using or planning to use LittleFe/BCCD for research.

Are you now using or planning to use your LittleFe/BCCD unit for research purposes?	
Yes	26
No	26
No response	5

Table 11: Use of LittleFe/BCCD in research

Short-Answer Response.

Answers to this question (F) varied widely, though many respondents mentioned research in parallel programming and HPC education as research topics.

F. If you are now using or planning to use LittleFe in research could you please briefly describe your plans?
Topic (# of times mentioned)
- Parallel programming (4)
- HPC education (4)
- Molecular dynamics (3)
- Computer security (2)
- Image processing (1)
- Cluster performance monitoring (1)
- Statistics (1)
- Numerical analysis (1)
- Graph theory (1)
- Data structures (1)
- Theory of computation (1)
- Quantum mechanics modeling (1)
- Energy (1)

As Table 12 shows, only 12 of the 57 participants, or 21%, indicated that they had submitted their 6-month and 12-month reports to the LittleFe team about learning, teaching, and research outcomes. No follow-up question was asked, so it cannot be determined from the survey data why this number is so low, but one participant did remark in a short-answer response that more reminders should be sent about the reports, which was also a concern mentioned by multiple participants regarding the development of curriculum modules.

Have you submitted you 6-month and 12-month reports to the LittleFe team that discuss these learning, teaching and research outcomes?	
Yes	12
No	36
No response	9

Table 12: Submission of 6-month and 12-month reports

Short-Answer Response.

A number of useful responses were provided to this question (G). These responses will likely be beneficial in improving the LittleFe/BCCD program, especially for future Buildouts and curriculum collection.

G. Do you have other comments on how to improve the use of LittleFe/BCCD to teach parallel programming and computational science in courses, outside of the classroom or in research?

- Better publication of curriculum modules
- Examples for Windows users to learn Linux
- Create a more active community through forums, social media, chat rooms, blog aggregators, newsletters, and/or a more active website
- More visually-appealing modules
- More modules for attracting middle school and high school students
- Improve the LittleFe's cooling system
- Dedicate more time to curriculum modules during Buildout events
- Consider expanding LittleFe's reach to developing countries
- More student-geared resources
- Clearer guidelines on what is needed for full participation in the program

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Student-only Questions

The following questions were only asked of students, though some participants who previously identified themselves as teachers also answered the questions. No mechanism was used to validate the participant's status as a student by the survey tool or during evaluation of the results.

Have you used LittleFe in your classes?	
Yes	8
No	3

Table 13: Student use of LittleFe in classes

Short-Answer Response.

Responses to this question (H) give students' perspectives on the impact of LittleFe/BCCD at their institutions. These responses provide some evidence of a positive effect on motivating students to study HPC and making it easier for them to do so.

H. If so, how has it impacted your education and the education of your classmates?
- Learned about HPC concepts and cluster computing through hands-on access
- Experience batch programming and MPI
- Motivation for exploring parallel computing
- Has led to several units being added to several courses
- Easy access to cluster resources where there was none previously

Have you used LittleFe outside of the classroom?	
Yes	7
No	6

Table 14: Student use of LittleFe outside the classroom

Short-Answer Response.

Responses to this question (I) show some of the ways LittleFe and BCCD have been used outside of the classroom. These responses give some evidence that LittleFe/BCCD can be used for outreach to students outside the core courses in which they are used, and as a recruiting tool into these courses.

I. If so, for what activities have you used it?
- Code benchmarking
- Presentations at elementary school summer camps
- Presentations for prospective students
- Demonstrations in courses outside the core curriculum

Conclusions and Recommendations

Roughly three quarters of the institutions who participated in LittleFe Buildout workshops fulfilled their obligation to take the survey. Participants of the survey were largely positive about their experiences using curriculum modules and developing their own. The survey results also point towards evidence of the use of LittleFe/BCCD in classes for teaching HPC concepts, in research, and in outreach activities. Participants who struggled with the use and creation of curriculum modules provided useful feedback on ways to make the process easier.

It is recommended that the LittleFe/BCCD team make every effort possible to solicit survey results from the remaining one quarter of the institutions who participated in the LittleFe Buildout workshops. The team should also implement as many as practical of the suggested improvements for curriculum module development and future Buildout workshops provided by the survey participants. In particular, efforts should be made to improve the communication about the expectations the team places upon Buildout participants with regard to the creation of modules. As new curriculum modules are developed, the team should quickly vette and publish these modules on the web to help participants with their use and creation. This will also provide a stronger indication of how the LittleFe/BCCD project is growing with each Buildout workshop and having a stronger impact on HPC and parallel computing education.

References

[1] Report on the SC12 LittleFe Buildout Survey.
http://littlefe.net/files/LittleFe_SC12_Buildout_Survey_Report.pdf

[2] Report on the SC13 LittleFe Buildout Survey.
http://littlefe.net/files/LittleFe_SC13_Buildout_Survey_Report.pdf

Appendix: Survey Questions

The following pages show all questions from the survey as they appeared to participants.

LittleFe/BCCD Buildout Project Post-Workshop Survey

Shodor > NCSI > 2013 Workshops > LittleFe evaluation > Surveys > LittleFe/BCCD Buildout Project Post-Workshop Survey

The main goal of the post-workshop questions is to understand how you have used or are planning to use the LittleFe/BCCD unit in your teaching, work and research. We would like you to complete this survey within a week or two of our request.

I. Background information

Which LittleFe Buildout event did you attend? *

Select...

What is your gender?

Select...

What is your ethnicity?

Select...

Where do you teach? *

Select...

If 'other', please explain:

If you are a teacher or faculty member, how long have you been teaching?

Select...

Have you ever attended an SC Education Program/HPC Educators Program before? *

Select...

If yes, which ones?

☐ Prior to 2005   ☐ 2007   ☐ 2010
☐ 2005   ☐ 2008   ☐ 2011
☐ 2006   ☐ 2009   ☐ 2012

Select All - Select None

II. Using Curriculum Modules with LittleFe/BCCD

These first questions ask you about LittleFe/BCCD curriculum modules you might have used. If you need to refresh your memory of the curriculum modules and their names please see:

- BCCD: http://bccd.net/
- CSERD: http://www.shodor.org/refdesk/
- HPCU: http://hpcuniversity.org/
- Undergraduate Petascale Education Program (Blue Waters): http://shodor.org/petascale/

Please rate the following statements on the existing LittleFe/BCCD curriculum modules.

	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	NA

Please rate the following statements on the existing LittleFe/BCCD curriculum modules.

	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	NA
Overall I think the existing LittleFe curriculum modules are useful for teaching about parallel programming and computational science.	○	○	○	○	○	○ *
Overall I think the existing LittleFe curriculum modules cover key topics in parallel programming and computational science.	○	○	○	○	○	○ *

Select None

What LittleFe/BCCD curriculum modules have you used or are you planning to use? Please name the modules and describe the types of use using the following types or levels of experience. *

We distinguish several types of use or levels of experience with a module. As appropriate, you can choose more than one type of use.

- Don't know - I have never used the module but am planning to at some point
- Know somewhat - I have used the module but not extensively
- Know well - I have used the module extensively
- Demonstrated - I have used the module and demonstrated it to students in classes or outside of classes
- Integrated - I have used the module and integrated the use of it into one or more of my courses
- Work or research - I have used the module in my own work or research

What could be done to improve the existing LittleFe/BCCD curriculum modules and their coverage? *

What could be done to improve the existing LittleFe/BCCD curriculum modules and their coverage? *

III. Creating Curriculum Modules for LittleFe/BCCD

Please note that instructions for creating modules are available at http://littlefe.net/curriculum.

We distinguish several stages of development or milestones for modules that you create.

As appropriate, you can choose several milestones.

1. **Planning** - I am doing initial planning or design of the module
2. **Implementing** - I am developing and refining the module code
3. **Completed** - I have completed and used at least a first version of the module
4. **Integrated** - I have completed the module and used in with students in courses
5. **Submitted** - I have submitted the module and documentation to LittleFe

Please describe the module(s) you have created or are planning to create and provide the stages of development using the above stages or milestones.

Module 1:

Milestone for Module 1:
Select...

Milestone for Module 1:

Select... ▾

Module 2:

Milestone for Module 2:

Select... ▾

Module 3:

Milestone for Module 3:

Select... ▾

If you have developed more than three modules, please tell us briefly about them here:

Please rate the following statements on creating LittleFe/BCCD curriculum modules.

	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	NA
The existing curriculum modules were helpful in creating new ones.	○	○	○	○	○	○ *
The instruction and support I got during and after the LitteFe/Buildout workshop were helpful in creating new modules.	○	○	○	○	○	○ *

Select None

What could be done to improve the creation of LittleFe/BCCD curriculum modules?

IV. Using LittleFe/BCCD for Learning, Teaching and Research
Please answer these if you are a teacher.

In what courses are you now using or planning to use your LittleFe/BCCD unit?

Please provide the course level, title and a description of possible.

If you are now using or planning to use your LittleFe/BCCD unit in courses, which modules are you are using or planning to use?
Select... ▾

If you are now using or planning to use your LittleFe/BCCD unit in courses, please name the modules you are using or planning to use.

	Very Good	Good	Satisfactory	Poor	Very Poor
If you are now using your LittleFe/BCCD unit in courses, what is your overall assessment of student learning and interest so far?	○	○	○	○	○
If you are now using your LittleFe/BCCD unit in courses, what is your overall assessment of your own experiences so far?	○	○	○	○	○

Select None

Are you now using or planning to use your LittleFe/BCCD unit for research purposes?
Select... ⬍

If you are now using or planning to use LittleFe in research could you please briefly describe your plans?

Have you submitted you 6-month and 12-month reports to the LittleFe team that discuss these learning, teaching and research outcomes?
Select... ⬍

Please answer these questions if you are a student.

Have you used LittleFe in your classes?
Select... ⬍

If so, how has it impacted your education and the education of your classmates?

Have you used LittleFe outside of the classroom?
Select... ⬍

If so, for what activities have you used it?

Please answer this final question if you are a teacher or student.

Do you have other comments on how to improve the use of LittleFe/BCCD to teach parallel programming and computational science in courses, outside of the classroom or in research? *