Executive Summary
of the Evaluation of the LEAD with GUITARS in STEM
2017 Summer Guitar Building Institute[1]

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For:

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[1] An Addendum to the LEAD GUITARS in STEM 2014-2017 Final Evaluation Report (Castañeda-Emenaker, I., Morrison, A. B., & Dariotis, J. K. (2017, June). *LEAD GUITARS in STEM Final Evaluation Report, 2014-2017*. Cincinnati, Ohio: Evaluation Services Center at the University of Cincinnati.)

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Background and Introduction

The one-week Guitar Building Institute (GBI) is the main professional development activity of the Sinclair Community College's NSF ATE DUE # 1304405 funded project called the Learning, Engaging, Attaining, and Doing with Guitars Used In Teaching Achievable Real Situations in Science, Technology, Engineering, and Mathematics (LEAD with GUITARS in STEM) project. The GBI starts the professional development for middle school, high school, and post- secondary faculty where they are trained in science, technology, engineering, and mathematics topics (STEM) through modules that used hands-on, applied learning techniques in building the components of a solid electric body guitar to engage students in learning the STEM topics. This Executive Summary Report is an addendum to the University of Cincinnati Evaluation Services (UCESC) 2014-2017 evaluation report dated May 2017, which included the project activities through March 2017. It highlights the project's maximized use of resources during its project extension year by hosting six additional GBIs from June through August 2017.

Sinclair Community College facilitated, along with its original five educational institution partners (Butler County Community College in Pennsylvania, College of the Redwoods in California, Edmonds Community College in Washington, Ventura College in California, and Purdue University in Indiana) and some new Project Champion trainers, the hosting of six additional one-week GBIs in Sinclair Community College in Ohio, Grants Pass High School in Grants Pass, Oregon, Mohawk High School in Eugene, Oregon, Johnston County Community College in North Carolina, Mt. Pleasant Delaware High School, and Maine from June through August 2017. There was a total of 84 GBI participants from 16 states from the west coast to the east coast (AK, CA, KY, ME, MD, MA, MI, MN, NC, OH, OR, PA, RI, TX, WA, and WV). Majority of the participants were White/Caucasian (85%), male (67%), high school faculty (67%), at least with Master's and doctoral degrees (58%) teaching across the different STEM fields. Forty-one percent of these faculty represented schools with more than 50% eligible with free and reduced lunch; 48% of the faculty represented schools with more than 50% underrepresented groups of students. Attachment A shows details of the US participants' GBI demographics. The project consistently involves female participants and increasingly choose more participants coming from schools with low socio-economic background and underrepresented population. To date the project reached at least 47 states across the United States other countries such as two providences in Canada, University of Medellin in Columbia and the Yirara College in Australia.

Evaluation Process

The focus of this evaluation is the summative aspect of the 2017 summer GBIs. Approach to this evaluation is guided by Guskey's (2002) five-level model for evaluating professional development: Level 1: Participants' reactions; Level 2: Participants' learning; Level 3: Organizational support and change; Level 4: Use of new knowledge and skills; and Level 5: Student learning outcomes. Given that the professional development activity is limited to the GBI for this evaluation, Levels, 3, 4, and 5 were based on participants' projected responses regarding support, use of knowledge and skills, and student learning outcomes.

Data collection for the evaluation of the 2017 GBIs included:

1) An online Retrospective Regular Survey that asked about participants' feedback about the GBI content, design, and environment; what participants learned and considered valuable from their GBI experience; how participants intend to use their learning; participants confidence in teaching, implementing, and applying STEM after their training; overall feedback about the GBI and their suggestions for improvement.
    - Participants from one of the GBIs (Maine) were not able to take part in the Retrospective Regular Survey; not everyone from the five GBIs were able to complete their regular retrospective survey because of time constraints in finishing their guitar.
    - 62 (74%) out of 84 total GBI participants; five GBIs (Delaware, North Carolina, Ohio-Sinclair, Oregon-Eugene, Oregon-Grants Pass) represented; of the 62 participants, 28% are female and 67% are male, 5% preferred not to answer; they are predominantly White Americans (85%); 55% has Masters degrees and 33% with Bachelor's degrees.
2) An online GBI Retrospective Short Survey that asked about participants' thoughts about the activities that would appeal most to their students; the skills set that students may learn and develop as a result of the implementation of the guitar curriculum, the projected total number of students participants reported they may impact with their learning and implementation of the GBI curriculum, the project support participants missed during the GBI, as well as the participants' overall thoughts about the institute.
    - The Retrospective Short Survey was launched after the Ohio GBI and therefore participants from this GBI were not able to complete this survey;
    - 71 (85%) participants out of 84 total GBI participants; participants from five GBIs (Delaware, Maine, North Carolina, Oregon-Eugene, Oregon-Grants Pass); 15 (21%) females; 56 (79%) males.
3) Participants' peer and self-assessment of their finished guitar product using the project generated Guitar Rubric Scores Instrument.
    - 62 (74%) out of 84 total GBI participants; all six GBIs represented: Delaware, Maine, North Carolina, Ohio, Oregon (Eugene & Grants Pass); eight (13%) females; 54 (87%) males
4) Participant developed and submitted Modular Learning Activities (MLAs) vetted by one of the project team experts.
    - No approved MLAs from participants of the Ohio and North Carolina GBIs
    - 38 approved MLAs from four institutes (Delaware, Maine, OR-Eugene, OR-Grants Pass) prepared by 10 (26%) females and 28 (74%) males.

Data Analysis for all quantitative included generation of descriptive statistics and paired t-statistics; thematic analysis (Guest, et.al, 2012) was conducted for all qualitative data. Were applicable, tables used in the 2014-2017 report were updated for 2017 to show comparison and/or trends in responses. Typical and representative quotes about the GBI are included in Attachment E.

Findings

Participants' Reactions. Overall participants had positive reactions toward the GBIs. Paired sample t-statistics survey results for participants' reactions toward the GBI content ($t_{(61)}= 6.34$, $p < .000$) design and environment ($t_{(61)}= 6.69$, $p < .000$) were all significantly changed/improved after the GBI.

Attachment B shows the 2017 participants' reaction in relation to the prior project year's results. Thematic results for all qualitative responses regarding participants' reactions toward the GBI support the quantitative results. For the participants, the GBI they attended was great, amazing, and the best professional development training they have, and that they learned with and from colleagues. They also noted the outstanding GBI instructors. Despite the overwhelming positive reactions, participants also identified that there was not enough time for guitar build and creation of a decent Modular Learning Activity (MLA). Additionally, participants suggested a need for: checklist of/resources for building phase [step by step process] to check progress of the build; better access and review of existing MLAs; models/examples of guitar parts and concepts in materials and build phase; consider ergonomics in the institute site/work space; and ensure at least one of the instructors has a STEM background.

Participants' Learning. The participants' guitar rubric scores on their finished guitar product, identified valuable learning, and the changed/improved participants' confidence about teaching, implementing, and applying STEM concepts were indicators of participants learning. More than 85% of both female and male participants scored more than 80% on the Guitar Rubric Scoring Instrument. Participants identified the top three most valuable learning for them: (1) all concepts; hands-on activities and connections with the classroom; (2) STEM interdisciplinary connections, and (3) knowing guitar parts and other related tools to use. Participants' confidence about teaching, implementing, and applying STEM concepts changed/improved significantly after the GBI ($t_{(61)}$= 9.57, p <.000). Attachment C shows details about participants' learning. Comparative tables where there were results presented from previous project years are included.

Organizational Support. The participants identified support they would have wanted to receive from the team during the GBI. The top three were: (1) written or video directions and model for each phase of the build with reflection for each phase; (2) development of MLAs - curriculum guide, sample implementation plan, and facilitation of group work to learn from each other regarding MLAs; and (3) having list of tools and resources, practice materials, discussion about bottle necks and production issues. Participants wanted a regular support throughout the year for challenges and issues they may encounter. They also expressed support need for grants/funding ideas and selling the guitar building curriculum to their students, administrators, fellow teachers, counselors, parents, and business community. They wanted support from the project team during the school year and in the future, especially as they encounter related implementation challenges and issues.

Use of new knowledge and skills. Participants use of knowledge and skills could be gleaned from participants' expressed intentions to use their learning from the GBI as well as their identification of guitar implementation activities that would appeal most to their students and how they intend to assess them. The top three expressed use of their GBI learning were: (1) engage students with STEM integration; (2) apply the guitar building concepts in the classroom; and (3) develop lessons that map to their school/district standards. Attachment D shows the 2017 details about participants anticipated use of knowledge and skills as compared to the previous project years. Participants identified interesting activities for their students. These include: design and hands-on building, shaping body parts, electronics and circuits and soldering, tuning and intonation, swirl dipping, CNC and use of power tools. Participants noted the need for them to develop rubric and other instruments to assess students' accomplishments with these activities.

Student Learning Outcomes. The period covered in this 2017 summer GBI evaluation does not include actual classroom implementation. However, participants identified the total number of students

that would be impacted by their implementation of guitar concepts as well as the job skills set their students are likely to gain with involvement with the guitar building curriculum. Participants identified a range of 10 to 200 students to be impacted by their guitar curriculum implementation. Variances in these numbers were due to the different grade levels taught by the participants as well as the differences in their school contexts. Participants identified hard and soft skills students are likely to acquire. For the hard skills, they indicated students likely learning manufacturing practice and processes, technical skills, CAD, electronics, and use of measurements. For the soft skills, about half of them identified potential development of work ethic, including responsibility, determination, follow-through, task completion, commitment to the job, timeliness, sense of quality (accuracy, precision, attention to detail, thoroughness). Additionally, about half of the participants noted that students will likely gain patience, resilience, sense of worth, problem solving, health and safety habits, team building, and communication skills.

Conclusions

Overall, as a professional development model, the 2017 summer LEAD with GUITARS in STEM GBI was successful based on the participants' reactions and concept learning, as well as their intent to use their learning, the projected support participants needed, and the projected students' outcomes in terms of the hard and soft skills participants anticipate their students would gain. The school year 2017-2018 would be telling as the participants start to implement the guitar building curriculum as they intended. The project maximized its funding with the extension of another year in 2016-2017 and hosting of six more additional summer GBI's reaching more than 80 faculty from at least 16 states across USA. To date the project reached at least 47 states across the United States other countries such as two providences in Canada, University of Medellin in Columbia and the Yirara College in Australia. Through the project years, the LEAD with GUITARS in STEM project team improved its program planning and implementation continuously as it learned from participants feedback and program evaluation. There are lessons learned from the project experiences and the participants' feedback that the project could use to improve the next round of professional development initiatives. Support and follow through during the GBIs are important to ensure that participants are on the same plane (as much as possible) and are able to meet GBI expectations and requirements (such as completion of surveys and MLA development). Support and follow through during the school year are also important to ensure that the faculty participants implement the guitar building curriculum with ease.

References:

Castañeda-Emenaker, I., Morrison, A. B., & Dariotis, J. K. (2017, June). *LEAD GUITARS in STEM Final Evaluation Report, 2014-2017.* Cincinnati, Ohio: Evaluation Services Center at the University of Cincinnati.)

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Attachment A
US Participants' Demographics

Distinguishing Characteristics of Participants' Schools

	2014 (N =65)	2015 (N=69)	2016 (N=104)	2017 (N=84)
More than 50% eligible for free and reduced lunch (low SES)	13%	21%	38%	41%
More than 50% underrepresented groups	3%	14%	13%	48%

GBI Faculty Participants' Demographics by Project Year

Demographics	2014 (N=65)	2015 (N=69)	2016 (N=104)	2017 (N=84)
Gender				
Male	71%	76%	80%	67%
Female	29%	24%	20%	28%
Prefer not to answer	0	0	0	5%
Ethnicity				
American Indian or Native American	0	0	4%	0%
Asian American	1%	2%	1%	2%
Black	3%	0%	4%	3%
Latino/Hispanic	0	7%	5%	2%
White/Caucasian	96%	80%	80%	85%
Pacific Islander	0	3%	2%	0%
Prefer not to answer	0	8%	4%	8%

Grade Levels Taught (Faculty may be teaching several grade levels)				
Grades 4-5	0%	0%	0%	7%
Grades 6-8	7%	13%	12%	21%
Grades 6-12	16%	17%	9%	47%
Grades 9-12	57%	37%	46%	67%
Grades 13-16	18%	33%	33%	31%
Other	2%	0	0	8%
Subject Area Taught (Faculty may teach one or more of these subject areas)				
Science	34%	16%	13%	31%
Technology	63%	14%	14%	55%
Engineering	41%	15%	21%	46%
Mathematics	20%	17%	17%	23%
Other	38%	38%	35%	42%
Educational Background				
Faculty participants with an associate's or bachelor's degree, or some college credits	50%	46%	38%	42%
Faculty participants with a master's or doctoral degree	50%	54%	62%	58%

Attachment B
Participants' Reactions re: Content, Design and Environment

Participants' Perspectives about Content and Design

	2014			2015			2016			2017		
	Pre	**Post**	**T-Test (Sig.)**	**Pre**	**Post**	**T-Test (Sig.)**	**Pre**	**Post**	**T-Test (Sig.)**	**Pre**	**Post**	**T-Test (Sig)**
Content												
Mean	4.42	4.82	$t_{(47)}$= 5.20	3.99	4.64	$t_{(68)}$= 5.55	4.53	4.79	$t_{(103)}$= 4.89	4.23	4.73	$t_{(61)}$= 6.34
Std. Dev.	.576	.265	p< 0.000**	.942	.543	p< 0.000**	.626	.533	p< 0.000**	.538	.357	P<0.000**
Design and Environment												
Mean	3.92	4.31	$t_{(47)}$ = 3.14	3.80	4.57	$t_{(68)}$ = 6.78	4.67	4.66	$t_{(103)}$ = 3.49	4.14	4.49	$t_{(61)}$= 6.69
Std. Dev.	.567	.404	p< 0.006**	1.008	.452	p< 0.000**	.790	.553	p< 0.001**	.445	.336	P<0.000**

Scale: 1 = strongly disagree…5 = strongly agree

Significance level: *p<.05; **p<.01; t-test was paired t-test, 2-tailed.

Attachment C
Participants' Learning

STEM Guitar Rubric Scores

- 87% of the female participants scored more than80% (only one out of the eight (13%) female participants had a score of 80% and below).
- 85% of the male participants scored more than 80%; (eight out of 54 (15%) male participants had a score of 80% and below).

What Participants Identified as Valuable Learning

Identified as Learned	2014 (N=54)	2015 (N=69)	2016 (N=104)	2017(N=62)
All concepts; hands-on and connections with classroom	41%	28%	24%	30%
STEM interdisciplinary connections	21%	25%	32%	30%
MLAs and use of assessments	2%	7%	4%	2%
Guitar parts and related tools to use; other resources	21%	32%	32%	25%
Collaborate with colleagues	13%	4%	8%	12%
Other (new activities; getting buy-in)	2%	4%	0%	2%
Total*	100%	100%	100%	100%

*Total may be a little more or less 100% because of rounding numbers.

Confidence about Teaching, Implementing, and Applying STEM

	2014			2015			2016			2017		
	Pre	Post	T-Test (Sig.)	Pre	Post	T-Test (Sig.)	Pre	Post	T-Test (Sig.)	Pre	Post	T-Test (Sig.)
Mean	3.64	4.74	$t_{(47)}$= 8.43	3.41	4.61	$t_{(68)}$= 6.78	3.85	4.75	$t_{(103)}$= 11.23	3.57	4.43	$t_{(61)}$= 9.57
Std. Dev.	.887	.343	p< 0.000**	.953	.705	p< 0.000**	.859	.455	p< 0.000**	.748	.504	P<0.000**

Scale: 1 = poor…5 = excellent; Significance level: *p<.05; **p<.01; t-test was paired t-test, 2-tailed.

Attachment D

Participants Intent to Use Learning

Participants Intent to Use Learning

	2014 (N=54)	2015 (N=69)	2016 (N=104)	2017 (N=62)
Apply in the classroom	**41%**	32%	30%	30%
Engage students with STEM integration	2%	**51%**	**38%**	**33%**
Develop lessons, map with standards	23%	7%	13%	14%
Use MLA and assessments	13%	3%	4%	7%
Build guitar models, extensions	7%	0%	0%	2%
Collaborate with Colleagues	1%	4%	12%	9%
Other (get funding, access and set-up resources)	9%	0%	3%	2%
Not sure; no response	4%	3%	0%	4%
Total	100%	100%	100%	100%

Attachment D
Sample of Significant Direct Quotes from the 2017 Summer GBI Participants

Overall Reactions about the Institute

The guitar build institute was one of the most useful professional developments I have participated in and will be eagerly urging other teachers and schools to look into this program.

This was by far the best thing I have every done since becoming an educator. Our principal and Assistant Superintendent should be meeting with me next week to try to get us rolling with a full STEM Guitar Building Course for next school year!!!

I have to admit, I was not really looking forward to this workshop due to lack of guitar knowledge on my part. This has really turned out to be the most amazing workshop I have ever attended! It really was life changing! I am very excited to implement this into my class next school year. This not only allows for academic instruction, but the very important soft / life skills our students are still learning or need to work on for their futures.

Reactions about the Content, Design, and Environment

I was very pleased with the content in the Institute. I learned a lot about the material I didn't know at all (i.e., shop tools, basic shop machinery, guitar making). I also learned some new applications of STEM material that I am very familiar with via the MLAs.

Every day was thought-provoking and engaging. It's hard to think of another workshop I've been to as a teacher that was as freaking cool as this one. This workshop literally rocks. It was really nice to be around so many knowledgeable people. It felt safe to ask questions and I always wanted to do my best no matter how long it took.

Excellent content, well-paced. I enjoyed the efficiency of the program and the small amount of downtime. We were constantly learning and applying what we just learned to cement the knowledge. If I had one suggestion, it would be to spend a bit more time on the classroom/ MLA side of things. I know this is difficult due to time constraints, but it would be helpful to see a more in depth look at the curriculum.

Comments about Need for Support

It would be good to provide a little more feedback and practice time. There simply was not enough time for all of the activities - such as sanding the bodies or putting on the finish and gloss. This could be resolved by adjusting the pacing of the activities, and providing a lot of feedback in the moment. There were times when the feedback was good, but opportunities for feedback seemed minimal.

I would have appreciated some more emphasis on wood: finish, coatings, chemistry of wood finish. I also only just began to appreciate the development of the actual build process. I envision a flowchart, to include steps of production, ratios of students to tools, dealing with bottlenecks of production (space, materials, tools availability), environmental concerns of dust, fumes, tool safety.

An online video module for each building component would be really cool. Maybe a livestream video hooked to a monitor so that demos can be seen more clearly, recorded and revisited. More of a flipped classroom model. Maybe a reflection and evaluation for each section.

Comments about Intent to Use Knowledge

I'll use this as a practical application/project across four sequential classes over the course of a year.

I have plans to implement the guitar hopefully this fall. I also plan to look at my other projects and see where common core and NGSS fit into my current curriculum.

I will use this learning to further advance the idea that STEM lives in ALL content areas. That STEM is not a content area in itself, but instead a methodology for delivery of rich academic content that is best taught in an applied, hands-on; minds-on environment.

Comments about Potential Student Outcomes

I believe for my students the biggest factor would be craftsmanship, work ethic and taking pride in a job well done. They also will gain a lot of specific art related and design skills.

Time management, quality control, measuring, CAD design, and CNC programming. These could be assessed through the rubric and overall quality of build. Students could grade each other's projects and recheck all aspects of the build. They could also be assessed through unit quizzes and exams.

Skills: Patience, communication, tool usage, shop safety, problem solving, trouble shooting, diligence. Assessing some of them are slightly difficult, but I would assess safety by the lack of accidents, problem solving by how well the final product turned out, trouble-shooting based upon each individual problem that they encountered, etc. Patience, communication and diligence would be more of a rubric and a self-assessment followed by a joint assessment.