PhysTEC 2020
Annual Evaluation Report

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About the Evaluation

Evaluation questions

The goals of the current PhysTEC project (from the proposal) are:

1. To engage a significant fraction of U.S. physics departments in developing programs to prepare greater numbers of highly qualified physics teachers
2. To test scalable levers for engaging physics departments in teacher preparation, and identify those which are most effective in different institutional contexts
3. To validate a model for thriving physics teacher preparation programs

In order to provide evaluation of these three goals, the current annual evaluation focuses on the following evaluation questions (from the evaluation plan):

1. To what extent are PhysTEC activities effective levers of change?
2. To what extent are PhysTEC activities scalable levers of change?
3. Are funded site outcomes and activities sustained over time?

As the project is in the middle of its implementation phase, most of the evaluation has focused on Question #1.
Methods

This annual report provides an overview of evaluation activities and findings in the 2019-2020 grant year (Year 3). This report draws on the following data sources and evaluation reports.

Reports

- PhysTEC 2020 Conference Evaluation (4/2020)
- Funded Site Graduation Evaluation (3/2020)
- Video conference feedback (12/2019)
- PhysTEC Fellows summative report 2018-2019 cohort (9/2019)
- PhysTEC Data Visualizations (5/2019)

Other feedback not contained in a formal report:

- Site visit recommendations and guidelines (12/2019)
- Teacher of the Year award (4/2019)
- Evaluation audit conducted December 2019 (following up on past feedback to project)
- Discussion of results and interpretation with project leadership and PMT.

Other tools:

- PhysTEC Portfolios: Reporting and data aggregation tool, using Google Sheets, for Comprehensive, Recruiting, and Fellows sites.

This report provides a synthesis and recommendations across these areas of feedback.

A summary of the findings of each of the above evaluation reports is provided in the Appendix: Summary of evaluation findings.
Synthesis

**Evaluation question 1: To what extent are PhysTEC activities effective levers of change?**

**Evaluvative response:** PhysTEC activities are reaching a wide variety of institutions and faculty, are well-received by those who engage in them, and are continuously improved by staff to enhance their effectiveness. Funded sites experienced statistically significant increases in numbers of graduates. Thus, PhysTEC activities are effective levers for change for the intended audience, with potential to grow this effectiveness. Evidence from this report is listed below.

The PhysTEC project has created an impressive portfolio of interventions. These interventions all aim to improve leadership, structures, and climate for physics teacher education in the U.S. through a variety of rewards, professional development conferences, and networking.

The number of qualified physics teachers is increasing as a result of the project. As demonstrated by past PhysTEC teacher graduation data, funded sites do increase their number of physics teacher graduates.

The PhysTEC project is learning from experiments with newer structures. These include particularly the Fellows sites, increased use of videoconferences, and State Networks. The project has solicited evaluation (and other) feedback on these structures, and iterated them significantly over time to best leverage these opportunities for engagement with stakeholders. PhysTEC staff engagement with the evaluator and evaluation findings is to be commended.

The PhysTEC project is also continuously improving its existing structures. Even well-established elements of the program have been conscientiously re-examined and improved, such as the conference, site visits and reporting structures for funded sites, and more. The PhysTEC staff engagement with the evaluator and evaluation findings is, again, exemplary. Many of the innovations and improvements within the project (e.g. videoconferences, PhysTEC mentors, site visit improvements, PhysTEC portfolios, and strategy for Fellows and Regional Networks) directly address concerns and challenges identified in the past few years.

These interventions are well-received by those who engage in them. In all evaluations, positive feedback is received from those engaged in PhysTEC, often indicating that the project:

- Helps them to prioritize an area that is otherwise difficult to prioritize
- Provides valuable opportunities to learn from an established network,
- Is very well-organized and run, and
- Includes knowledgeable and dedicated staff.
**Evaluation question 2:** To what extent are PhysTEC activities scalable levers of change?

**Evalutive response:** PhysTEC is aiming to scale up and to scale out its interventions, to achieve broader impacts. To achieve such scale, it is appropriate to provide a broad range of funding tracks and interventions which engage a larger number, and different types, of faculty and institutions. The costs of such scaling include investment risks (e.g. the cost of unsuccessfully funded sites), which can be mitigated by offering more numerous smaller grants, and being highly selective with the funding of larger grants. Another cost is staff time and energy, suggesting that innovative programs must be carefully evaluated for cost-benefit ratio once they have reached optimal performance. While PhysTEC is reaching a range of faculty within departments (enhancing scaling) PhysTEC might also consider reaching a range of actors at different levels of the system (e.g. administrators, schools of education, state-level actors) to further achieve scale. Lastly, PhysTEC’s commitment to continuous improvement enhances their ability to successfully achieve scale through dynamic adjustment of interventions based on lessons learned.

One of the aims of the PhysTEC project is to scale PhysTEC’s influence to achieve broader impacts. I will briefly analyze scaling in PhysTEC through the lenses of scaling science for social impact.

There are two main scaling approaches apparent in PhysTEC’s approach:

1. **Scaling up** -- spreading existing PhysTEC interventions to more institutions and faculty. This is primarily achieved by continuing to engage institutions in existing PhysTEC grants (i.e. funding more Comprehensive and/or Recruiting sites), engaging more institutions through new opportunities (such as Regional Networks) and engaging more people in other existing innovations (conference, teacher of the year, etc.).

2. **Scaling out** -- engaging a wider variety of institutions and faculty in physics teacher preparation, primarily achieved by expanding the portfolio of interventions (e.g. Fellows, Regional Networks).

**McLean and Gargani (2019)** suggest considering the following principles\(^1\) when considering scaling an intervention: Optimal scale, inclusive coordination, and dynamic evaluation. I consider these each in turn below.

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\(^1\) For simplicity, I have combined their “moral justification” and “optimal scale” principles.
[1] Optimal scale

What is the optimal scale, given that costs and benefits will not scale linearly? What are the risks of scaling (up or out)? What is the cost of failure or likelihood of negative impacts? See figure below from Gargani and McLean (2017).

- Scaling up (spreading existing interventions to more institutions and faculty): For interventions such as awards and conferences, the risk-to-reward ratio is acceptable; these are fixed-cost interventions and adding institutions is desirable for spreading impact. For funded sites, the Funded Sites Graduation Study showed that the certainty of impact is acceptably high, but there is a lower investment risk associated with smaller funding amounts (e.g. Targeted, Recruiting sites). This suggests that the number of Comprehensive sites should likely stay constant over time, but the number of smaller grants could comfortably expand in the future.

- Scaling out (expanding the portfolio to different types of institutions and faculty): The main apparent risk in scaling out is the increased burden on PhysTEC staff time and attention, as they manage a wider portfolio of projects, as well as providing logistical and informational support to funded sites. The overburden of staff is not an insignificant risk, and suggests that the experimental programs should be evaluated for impact vs. risk once they have become better established, to determine if the impacts merit the cost.
[2] Inclusive coordination

How can you include the various actors who would make it possible to address a problem at scale?

- For both scaling up and scaling out, PhysTEC’s various interventions fundamentally provide engagement for a wide variety of actors, including current and future champions for physics teacher education, as well as more tangentially interested actors, and those within a region. Thus, offering a variety of interventions which speak to a variety of faculty and institutions is appropriate. That said, these interventions typically engage diverse actors at a single level of the educational system (physics departments), due to PhysTEC’s strategic focus. PhysTEC may wish to consider if they need to engage actors other across other levels of the educational system, such as department chairs, more integrated partners in schools of education, in-service teachers, and state-level certification boards.

[3] Dynamic evaluation

Use a continuous and adaptive evaluation process to provide feedback and adapt innovations as they engage in scaling.

- For both scaling up and scaling out, PhysTEC’s engagement of internal and external evaluation and reflection is evident in its continuous improvement processes, and contributes to the ability to scale successfully. However, PhysTEC staff’s ability to substantially incorporate strategic improvements to its programming is likely to be challenged by managing multiple new programs.

Evaluation question 3: Are funded site outcomes and activities sustained over time?

Evaluative response: Largely, yes, funded site outcomes are sustained; The majority of funded sites in the past have been sustained over time, as evidenced from the Funded Site Graduation study, where half sustained or increased their graduation gains, and the other half experienced losses of only one teacher. More evidence will accumulate regarding this evaluation question over time, as we engage in sustainability studies of Targeted, Recruiting, and Comprehensive sites over the next year, with the support of the PTEPA Rubric to allow us to assess structural sustainability and not simply sustainability of graduation numbers.

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In sum, PhysTEC activities and interventions are generally effective and scalable levers of change, and early evidence suggests that changes at funded sites are often sustainable.
Recommendations

Based on these findings, I suggest the following considerations for project effort and scope.

Areas to focus effort

Given the noted challenges of staff time, some areas of focus to help generate effective, scalable interventions are suggested.

1. **Prioritize iteration of newer experimental programs over well-established programs.** When you are challenged by competing priorities, focus attention on the more experimental elements of the PhysTEC portfolio, such as Fellows, Regional Networks, videoconferences, and PhysTalk. Regional Networks have been slow to evolve, and may require staff support and engagement for the newer sites to engage productively.

2. **Prioritize improvements that will increase engaged faculty’s ability to:**
   a. Prioritize physics teacher education among their myriad responsibilities, and
   b. Learn from one another.

   These appear to be two consistently identified benefits of engaging in a variety of PhysTEC programs, and so may be valuable focal points for the myriad of interventions and improvements -- including conference, network, supported sites, awards, website, PhysTalk, and more. For example, the Fellows often indicated that a main benefit of the Fellowship is that it creates a space and opportunity to spend focused effort on PTE -- an excuse to allocate some precious time and attention to this issue. What other programs and interventions help to do this?

3. **Prioritize helping legacy sites (including Fellows) sustain their structures and engagement.** Another area of focus ought to be helping the current and past Fellows sites to sustain their engagement and activities. Past Fellows have just completed their active engagement, legacy sites may require more active support. Again, a focus might be on engagement that will help them to:
   a. Prioritize physics teacher education, and
   b. Learn from one another.

Areas to consider in project scope

Given the intention to scale interventions both up and out, some suggestions for project scope are listed. These may be most appropriate for future grants, but could suggest bounded experiments in the short term.
1. **Offer more small grants, and carefully screen larger (Comprehensive) grants.** Smaller grants have lower investment risk, and spread the interventions and engagement to a broader range of faculty and institutions.

2. **Evaluate the portfolio of interventions for cost/benefit to determine future offerings.** Once newer programs are more established, careful evaluation of impacts compared to programmatic costs should inform whether such innovations are taking resources away from more impactful programs.

3. **Consider engaging actors across multiple levels of the educational system.** PhysTEC’s focus on the department is appropriate, but to scale they may wish to consider if they need to engage actors across other levels of the educational system, such as department chairs, more integrated partners in schools of education, in-service teachers, and state-level certification boards.
Appendix: Summary of evaluation feedback, Year 3

In this appendix, the feedback provided by different aspects of the evaluation will be summarized, as well as PhysTEC responses to each evaluation component. Staff responses are summarized from a Google Doc where program responses to evaluation feedback are logged after a submission of evaluation feedback.

(1) Evaluation regarding supported sites

PhysTEC Portfolios

The evaluation undertook a project to streamline reporting from PhysTEC sites (Comprehensive, Recruiting, and Fellows) due to the fact that it was difficult to get a holistic picture of each site’s characteristics (for internal or external evaluation use) and that the annual reporting did not seem to build insight from year to year. The PhysTEC Portfolios were developed as a suite of Google Sheets for sites to complete regarding their site background, goals, and graduation numbers, to streamline reporting and data gathering. Magnolia Consulting and Chasteen Educational Consulting collaborated on the final product.

PhysTEC Portfolios were provided to Comprehensive sites and Fellows in 2019, and Recruiting sites in 2020, with the fully functional Portfolio released in April 2020.

Goals of Portfolios:
1. Enhance local program impact and help with decision making, including building site capacity and good reporting habits.
2. Allow easy insight into what a site is trying to achieve, by PhysTEC staff and mentors.
4. Monitoring sites for compliance.

Design features:
1. Collaborative
2. Simple and non-redundant
3. Central (one-stop shop)
4. Support action planning
The table of contents (spreadsheet tabs) of the Portfolio are shown below:

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<tr>
<td>Overview</td>
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<td>Annual activity and reporting</td>
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<td>Year 1 Activity Tracking</td>
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<td>Student Tracking</td>
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<td>Products</td>
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<td>Site Visits</td>
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<td>PTEPA</td>
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<td>Data Tables</td>
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Major components of the Portfolio include:

- Site background
- Goals
- SWOT
- Activity tracking (annual)
- Annual report (annual)
- PTEPA results
- PTaP results
- Student tracking data
An example of data entry in the Portfolio is below.

**2. PhysaTEC Awarded Site or Fellowship**

**2.1 Award Information**

Budget: Identify the five main areas funded by your budget, and indicate the approximate % of funding allocated to each area. This is not for tracking purposes, but rather to identify the main areas of focus. Possible main funding areas are: TIR, personal other than TIR (e.g. PI), other participant support (e.g. IAs), travel, or materials.

<table>
<thead>
<tr>
<th>Number</th>
<th>Item</th>
<th>Dollar Amount</th>
<th>Approximate % of funding</th>
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<td>$25</td>
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<tr>
<td>2</td>
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<td>5</td>
<td>Text</td>
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*Fellow: When asked to report on the period of your award, please just consider the term of your Fellowship.

**2.2 Project Summary**

Proposal summary

[Optional text for proposal summary]

*How will you sustain your activities past this project? Please be sure to detail any institutional commitments that have been made.*

E.g., Unit Y will fund the half-time TIR, and Unit Z will fund the LA program, for three years. We will collect data on program successes regularly to garner ongoing support beyond the 3 years post-funding, both internally and externally.

An example of data display on the annual reporting tab is below.

**Q1 Reflect: Are you recruiting and retaining enough students?**

- PTaP (student) scores, by desire to teach grade 7-12
- Percent of students in teaching
- Percent of students in planning to pursue certification
- Percent of students with interest in teaching
- Percent of students in neutral
- Percent of students who do not want to teach

**Recruitment pool (from Strategic Planning tab):**
- Introductory Physics Course (enrolled): 1
- Undergraduate Physics majors (declared): 2
- Physics-aligned majors (declared): 4
- Master’s degree in physics (awarded): 5
- PhD in physics (awarded): 5

**Estimated recruitment pool:** 17

Project response: Project staff has been intimately involved in development of the Portfolios, which are serving as the annual Scope of Work and report for supported sites, including Fellows.
Video conference feedback

A casual evaluation of PhysTEC video conferences (including feedback from Allie Lau) found that videoconferences for supported sites:

- Respected everyone’s time.
- Are task-oriented.
- Create a safe space.
- Encourage discussion.
- Could include more productive bids for reflection and dialogue.
- Could include clearer facilitator roles.

Recommendations

- Consider the facilitation principles from the Faculty Online Learning Communities to provide some guiding principles for PhysTEC video conferences (e.g. time should matter, encourage dialogue).
- Consider what can be done offline through email, versus in-person.
- Create clearer facilitation guidelines between David and Monica.
- Create opportunities for dialogue.
- Make the purpose of activities clearer up-front.
- Create a brief checklist for videoconference prep which captures commonly difficult things, such as “Consider what can be done by email prior to the meeting.”
- Consider setting norms around note-taking, and requesting to speak.

Project response: PhysTEC is now using most of these recommendations and attempting to follow the basic principles that underlie them. PhysTEC has drafted and begun using documented guidelines for running video conferences with sites. We expect to assess and revise these guidelines as appropriate in the future, based on our experience using them and on further guidance by the evaluator.

PhysTEC Fellows summative report (2018-19 cohort)

This was a summative report across several formative feedback reports on the Fellows program. In general we find that:

1. Fellows make meaningful progress towards their goals.
2. Engagement in Fellows is seen as a useful way to prioritize teacher preparation.
3. The current action-planning process does not seem to be particularly useful.
4. Knowledge exchange is an important value-added of being a Fellow (including conference attendance).
5. Fellows want to interact with and learn from other Fellows.
6. Responses to the videoconferences are mixed.
7. Fellows appreciate the tasks and homework assigned, including the PTEPA.

Feedback included:
1. Focus on peer learning as a goal (though not necessarily network formation) in video conferences and at the conference.
2. Make some changes to the video conferences to support peer learning.
3. Make some changes to the action planning process.
4. Consider whether to consider Fellows as a “Community of Transformation” (Kezar).

**Project responses:** We modified the Fellows videoconferences to better support peer learning and they met informally at the PhysTEC 2020 conference. The initiation of the Senior PhysTEC Advisors is a significant change designed to provide support to sites (including Fellows) while saving staff time. Their strategic planning will be supported going forward using the PhysTEC Portfolio.

**Site visit recommendations and guidelines**

After engagement on a site visit, the evaluator made several suggestions to the “site visit guidelines” for PhysTEC site visits, and the information given to sites, including:

1. Consider pre-visit discussion or survey with a site to identify their priorities.
2. Better document the process and expectations for site visits internally.
3. Bring useful documents and materials to a site visit.
4. Consider connecting the external site visitor more closely to the site team.

**Project response:** PhysTEC has worked closely with the evaluator to incorporate feedback over time; see responses to “video conference feedback” to see relevant responses there. At the Conference, Fellows met informally at the Friday night dinner (with staff and supported sites), and then met with their mentors Saturday night. One Fellow led a workshop. The initiation of the mentors program (“Senior PhysTEC Advisors”) is a significant change designed to provide support to sites while saving staff time. The PhysTEC Portfolios are the new strategic planning support for Fellows.

**Evaluation regarding project activities**

**PhysTEC 2020 Conference Evaluation**

**Overall.** The PhysTEC 2020 conference was successful at achieving its goals to provide information and connection to a growing network of physics teacher educators. Indications of the success of the conference include:

- Positive comments on the end of conference feedback form.
- Positive ratings on individual session feedback (average rating: 85%).
- A wide variety of intended actions that participants plan to try when returning home.
- Reports of key changes in perspective on the part of participants.
- Evidence of continuous improvement of the conference on the part of PhysTEC staff.
Motivations: Many participants attend the conference to network, share ideas, share information from their own program, and learn from successful programs. When prompted to go deeper into their motivations, participants most often named big-picture goals (such as desiring all students to be able to learn physics), a public mission, and satisfaction.

Challenges: Participants were asked to self-rate their challenges to training physics teachers. “Perceptions of teaching” (by students, faculty and the public) was the top-rated challenge, with “the teacher certification process is too long or expensive” coming in close behind. Several other challenges named were specific to the certification process and state requirement, as well as program funding, coordinating with the school of education, and challenges of a small department.

Session ratings. The session ratings are informative in noting exemplary and potentially problematic sessions, and feedback was sent to presenters.

Actions. Most participants were able to note concrete actions they plan to undertake, most commonly the use of Get the Facts Out, actions related to a Learning Assistant program, recruiting strategies, or use of the Underrepresentation Curriculum or Periscope.

Perspective. Many participants also noted changes in perspective as a result of the conference, such as:
- Gaining a national perspective (e.g. it’s worse than I thought).
- Gaining confidence or clarity in their work (e.g. useful advice from others).
- Understanding the needs of teachers.
- Expanding their view of potential partnerships.

Project responses: As of the writing of this report, PhysTEC responses to the conference evaluation were not yet due.

PhysTEC Data Visualizations
The evaluator conducted a review of visualizations used in PhysTEC data and found that data were not always presented in a persuasive fashion, and provided suggestions for improvement.

Project responses: One graphic about the teacher shortage was redesigned using these recommendations. The recommendations were shared with the PhysTEC PMT in Winter 2020. Staff have not yet redesigned other data visualizations, but in Spring 2020 will make a plan for updating the most critical charts and graphs using these recommendations.

Teacher of the Year award
The evaluator solicited feedback on the Teacher of the Year award on the post-conference survey in 2019, and made the following recommendations based on those findings:

1. Advertise the selfish benefits of the award as a way to provide recognition and visibility for the
program (as well as teachers and teacher education).

2. **Get the word out** to those not part of PhysTEC, such as school districts and state sections of AAPT.

3. **Share concrete ideas on how to identify teachers** for TOTY, perhaps with stories on how a nominee was found, or how interaction with K12 schools can help a PTE program and identify candidates.

**Project response:** These recommendations informed the program strategy for Teacher of the Year.

**Evaluation audit**

At least once each year, the evaluator conducts an “evaluation audit” where past feedback to the project is reviewed, and staff are asked to indicate project response. This process has several benefits:

1. Provides feedback to the evaluator about the recommendations that are most transformative.
2. Reminds the evaluator and staff about evaluation feedback, to support learning.
3. Generates action items related to the evaluation feedback.
4. Documents project response for reporting and accountability purposes.

The evaluation audit was submitted to staff in December 2019, and staff responded by the end of March 2020. Overall, the evaluator is satisfied and pleased with staff engagement in the evaluation, and incorporation into project processes.