PhysTEC 2022
Annual Evaluation Report

May 12, 2022
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This report was primarily supported by the National Science Foundation under grant number PHY-1707990.

Table of Contents

About the Evaluation ........................................................................................................................................... 1
Annual Report ......................................................................................................................................................... 2
  Evaluation Question #1: To what extent are PhysTEC activities effective levers of change?................................................................. 2
  Evaluation Question #2: To what extent are PhysTEC activities scalable levers of change?................................................................. 5
  Evaluation Question #3: Are funded site outcomes and activities sustained over time? 8
  Evaluation Question #4: Is the PhysTEC Theory of Change supported as a model for physics teacher educational change? ................................. 11
Conclusions and Recommendations ....................................................................................................................... 15
About the Evaluation
To evaluate PhysTEC’s goals this annual evaluation focuses on the following evaluation questions (from the evaluation plan):

<table>
<thead>
<tr>
<th>Evaluation questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To what extent are PhysTEC activities <em>effective</em> levers of change?</td>
</tr>
<tr>
<td>2. To what extent are PhysTEC activities <em>scalable</em> levers of change?</td>
</tr>
<tr>
<td>3. Are funded site outcomes and activities sustained over time?</td>
</tr>
<tr>
<td>4. Is the PhysTEC Theory of Change supported as a model of change?</td>
</tr>
</tbody>
</table>

Over time, the evaluation focus has shifted from the top of this list to the bottom, and in 2022 the focus has been on #3 and 4: Sustainability, and validation of the PhysTEC model. This annual report provides an overview of evaluation activities and findings in the 2021-2022 grant year (Year 5). This report draws on the following data sources and evaluation reports.

Reports
- 2022 PhysTEC Online Conference Evaluation
- 2022 Funded Site Graduation Rate Evaluation
- 2022 Regression of PTEPA and Graduation Rates
- 2021 Graduate Pathway Analysis
- 2021 Comprehensive II Site Sustainability Study
- 2022 PTEPA Reliability Report
- 2022 New York Regional Network Member Survey

About the sustainability studies
This evaluation has conducted a series of sustainability studies of Targeted Grants, Recruiting Grants, and most recently Comprehensive Grants. This year’s sustainability study focused on the sustainability of 16 PhysTEC Comprehensive Grants funded from 2010-2015 (“Comprehensive II sites”). This was a significant evaluation effort and so the results are reported in some detail for this NSF report. Evaluation questions included whether the number of physics teacher graduates increased, and sustained, what PhysTEC activities were sustained, and what factors contributed to sustainability. This time period spans 5 different requests for proposals. Funding amounts were typically $300,000 over 3 years, plus a recommended 3-year institutional match; UTeach replication sites were funded at a lower level. Data gathered included archival documents, graduation data, a written survey, and a series of interviews, including completion of the Physics Teacher Education Program Analysis (PTEPA) Rubric. The desired outcomes included:

(1) Institutional capacity and culture for physics teacher education (PTE), such as leadership, resources, structure, and policy, and
(2) Sustained PTE program outcomes, such as graduation and an effective PTE program. Sites were given a “sustainability” rating based on multiple measures: Unsustained, Mixed, Sustained, and Grew.
Evaluation Question #1: To what extent are PhysTEC activities effective levers of change?

Evaluative response: PhysTEC activities are highly effective for increasing graduation rates, building community and knowledge, generating durable structures, and creating proof-of-concept for physics teacher education. Comprehensive sites achieve meaningful results for institutions, supporting organizational capital and a healthy ecosystem for physics teacher education.

PhysTEC funding is associated with significant increases in the number of teacher graduates of 1-2 graduates/year. The value and effectiveness of PhysTEC activities has been repeatedly demonstrated in evaluation results, with engaged participants citing the value in gaining access to a supportive community and collective wisdom about physics teacher education. Teacher graduation rates increase at supported sites, graduates have strong content preparation, and supported sites have strong physics teacher education programs. This year’s evaluation of the 2022 Conference, and the New York Regional Network continues to support the conclusion that PhysTEC activities are highly effective.

PhysTEC funding is associated with significant gains in graduation rates.

Report: Funded Sites Graduation Rate Evaluation

I conducted quantitative analysis of student graduation rates. Sites included were all N=41 sites funded since 1998 (26 Comprehensive, 8 Targeted, 7 of 9 Recruiting with complete data). The average gain in physics teacher graduates during funding was nearly one graduate (+0.9 graduates); this gain is statistically significant (p<0.001). This significant effect remained even when department size and pre-funding teacher graduation rates are considered. Most funded sites (71%) experience gains of at least 0.5 teachers; among these sites that do experience growth, the average gain is +1.9 graduates.

PhysTEC graduates have strong content preparation

Reports: Graduate pathway analysis

Using reported teacher tracking data from all PhysTEC current and legacy sites (42 institutions and 921 student graduates) I found that most (67%) of PhysTEC graduates are physics majors or equivalent, showing strong content preparation. The others are physics minors (14%), physics education majors or minors (15%), or unknown.
PhysTEC supports strong culture, norms, and capacity for PTE, and created strong PTE programs. Thus, graduates at these institutions are well-prepared. Report: Comprehensive II Site Sustainability Study

The most important outcome for the N=16 institutions included in the Comprehensive II study was stated as being the supportive culture for teacher education. Site leaders were overall proud of the results of the grants, and the quality of education provided for teacher graduates. Based on the PTEPA Rubric, PhysTEC supported many improvements in PTE programs, such that Comprehensive II sites rival the strength of thriving programs in terms of program structure and practices (figure below).

![PTEPA Rubric: % items at least Benchmark, compared to Thriving Programs](image)

LA programs, curricular changes, and recruitment practices were commonly mentioned durable outcomes, and institutionalization of LA programs was somewhat common. Students at former PhysTEC sites also receive quality preparation regardless of site sustainability: All sites (including “unsustained” sites) were found to have strong ratings in the PTEPA “Knowledge and Skills” standard -- this standard includes physics content and pedagogy, and field experiences. Additionally, nearly all sites experienced positive growth in PTEPA ratings during PhysTEC funding, regardless of sustainability level, showing that Comprehensive grant funding improved PTE programs.

**PhysTEC’s successes promote a positive feedback loop, providing proof-of-concept for PTE.** Report: Comprehensive II Site Sustainability Study

Often, success bred success; the PhysTEC grant enabled site leaders to establish “proof of concept” that PTE was viable: That there was interest among students, there is demand for courses, graduation numbers could increase, and Teachers in Residence (TIRs) and Learning Assistant (LA) programs could be valuable for the department. LA programs especially supported a strong culture for teacher education, which then supported the LA program. The
institutional match period often helped establish the value of these program elements and create funding and routine to support them.

**PhysTEC conferences generate knowledge and connection, but face-to-face is a good next step.**

Report: PhysTEC 2022 Conference Evaluation

Respondents overall felt they gained value from the 2022 online conference in terms of knowledge gain and other benefits. They were overall satisfied with their experience at the conference. Participants were ambivalent on this year’s “unconference” format. Many appreciated the level of open discussion which was supported by this conference format and the ability to choose topics they wanted to discuss. Attendees were strongly mixed on the value of the online conference; many want to have a hybrid or online component in the future, but just as many requested that it be held face to face in the future. Overall, this was a solid conference and people enjoyed it. But the reaction to this conference is not as strongly positive as it has been for other PhysTEC conferences (face to face, or 2021 online).

**Regional networks hold promise for collective action and community-building**

Report: New York Regional Network Member Survey

The New York Regional Network surveyed its membership in 2022. A total of 15 people responded. A core group attends the meetings regularly, with 7 respondents attending 6 or more network meetings, and all indicated that it was likely or very likely that they would continue to be involved two years from now. Respondents were overall very satisfied with the progress of the network, having gained information, enjoyed the talks, and made connections with others. They particularly value the professional connections, collaborative culture, and variety of talks focused on regional issues. Some are interested in engaging in more collective activism and projects. The vast majority feel that they’ve gained access to key relationships, knowledge, or skills, and they feel reenergized in their work. They also feel that there are opportunities for open dialogue in the network. The main growth areas are (1) feeling connected to a national community and the associated resources, and (2) impacts on advancing physics teacher education at their institution. Overall, these results show that the New York Regional Network is creating a positive climate for collaboration and is poised for collective action.
Evaluation Question #2: To what extent are PhysTEC activities scalable levers of change?

Evaluative response: PhysTEC activities are cost-effective and reach a variety of institutions. The key gaps in scalability are (1) the variability in success rates of non-Comprehensive sites and (2) supporting postbac pathways.

The various levels of PhysTEC funding (large Comprehensive grants and smaller Recruiting and Targeted grants) all demonstrate success. While fewer of the small grants demonstrate long-term gains in graduation rates, their reduced cost results in lower investment risk and the possibility of improved cost-benefit ratio over larger grants. However, return on investment is very reasonable for all grants, at only $3,000 per year of teaching, and $30,000 per graduate (or less). This return on investment suggests that PhysTEC activities appropriately scale-up change to more institutions. However, a central question remains how to effectively support smaller institutions, or those who are newer to physics teacher education. While Comprehensive grants produce certain gains, they are not appropriate for all institutions, and smaller grants may be more cost-effective. I also find that half of PhysTEC graduates are certified to teach through post-baccalaureate pathways, and that institutions with postbac pathways have greater sustainability. Thus, an important element of scalability is supporting institutions in creating diverse pathways to teacher certification.

Comprehensive sites generate greater sustainable gains than other, smaller, funding tracks – but all demonstrate success.

Report: Funded Sites Graduation Rate Evaluation

Returning to the longitudinal results of the N=41 sites funded since 1998, we compare the 3 funding tracks. Comprehensive sites experience greater gains in numbers of teacher graduates (+1.1 graduates) from pre-to-during funding compared to other tracks (+0.6 graduates). Comprehensive grants also demonstrate greater overall pre-post gains (+1.1 graduates) compared to other tracks (+0.2 graduates); see figure to right and below.

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1 Comprehensive ($300,000), Targeted ($75,000) and Recruiting ($30,000). Targeted grants are no longer offered but provided ample staff and professional development support. Recruiting grants are based on the first Recruiting cohort which offered less staff support.
A greater fraction of Comprehensive sites experiences gains (65%) pre-post funding than other funding tracks (38%, 29%), and the increase in teacher graduation rates for those sites with gains is greater for Comprehensive sites (+2.1 graduates) than for other types of sites (+1.0, 1.3).

Return on investment is reasonable and robust at only $3,000 per year of teaching. Smaller grants may be more cost effective.

Report: Funded Sites Graduation Rate Evaluation, National Advisory Board presentation

To calculate cost-effectiveness of the different funding levels, I calculated a variety of cost-effectiveness measures. For these measures I include a hypothetical “Recruiting +” grant which is more aligned with the current Recruiting grants. The figure at right shows that Comprehensive grants, on average, generate more 12 new teachers over their lifetime than they did before PhysTEC; Recruiting+ only generate 4 new teachers, but they cost less.

The cost per graduate ranges from $15,000-$30,000, which is on par with the Noyce grant costs. Each graduate teaches for multiple years; thus, the cost per year of teaching is only $2,900/year for Comprehensive grants, and even lower for Recruiting+ grants ($2,000/year); figure below.

The investment risk, or the amount of money spent on sites that do not ultimately produce more teachers, is also lower for smaller grants.

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2 Recruiting + = funding and staff support at the current Recruiting grant level, graduation rates of Targeted grants.
3 Cost per graduate = Grant cost / Estimated total number of new teachers (during funding, & 10 years post funding)
4 Cost per year of teaching = Cost per graduate / estimated years in profession.
5 Investment risk = Grant cost * fraction of sites without pre/post gains.
Thus, Comprehensive grants provide robust outcomes with strong return on investment, but smaller grants are an important part of scalability. Smaller grants provide start-up costs for those not yet ready for a larger grant, and engage smaller institutions. However, the large range of graduation rates from smaller grants results in a large error bar on the number of graduates from Recruiting+ sites. Smaller grants can be cost effective, but this is highly dependent upon staff support, and is unstable from year to year. A central question for the project is whether the increased cost of the Comprehensive grants is worth the uncertainty of the gains, and how to best support institutions in achieving success with smaller grant inputs.

**Half of PhysTEC graduates are certified through a postbaccalaureate pathway.**

Report: Graduate pathway analysis

Using reported teacher tracking data from all PhysTEC current and legacy sites, I analyzed the type of certification routes used at PhysTEC institutions. A total of 42 institutions and 921 student graduates were included in the analysis. I found that **Postbac certification is a very common certification pathway.** When analyzed across students, 53% of students are certified through a postbac program (which may include going to another institution to receive that postbac training.) When analyzed across institutions, 48% of students (on average) at an institution receive certification through a postbac route. These percentages have remained steady over the past 15 years. This finding suggests that it’s important for PhysTEC to strategize how to support institutions in creating and maintaining good postbac pathways to certification. In the Comprehensive II Sustainability Study, I also found that institutions with postbac pathways were more likely to have sustained success. PhysTEC has historically focused on undergraduate preparation, and so an increased focus on the popular postbac pathway is an important element to consider.
Evaluation Question #3: Are funded site outcomes and activities sustained over time?

Evaluative response: Funded site outcomes are maintained to varying degrees but are more consistent for Comprehensive sites. Institutional culture, leadership, and resources are related to sustainability.

Comprehensive sites are, overall, sustained, with meaningful outcomes which persist over time. These outcomes include structural changes, organizational capacity building, and leadership, all of which have the potential to continue to maintain outcomes. Leadership, time, and effort are the main points of fragility in a program, in addition to threats which are not able to be mitigated. The sustainability results of other types of grants (Targeted, Recruiting) are more mixed – PhysTEC grants always generate durable and important outcomes in leadership and capacity, but not always in graduation rates. Across all types of grants, structural outcomes (e.g., creating a new program or course) are most often maintained. Lack of human and financial resources tend to be related to a lack of sustainability, and institutional culture, number of majors, and postbac pathways are related to sustainability. Time, effort, and leadership are points of fragility for all programs.

Comprehensive sites maintain their graduation rates after the funding period (to first approximation) but other types of grants are mixed

Report: Funded Sites Graduation Rate Evaluation

As shown in graphics on page 5, the Comprehensive grants tend to maintain their graduation rates: The average change from during-to-post funding periods is 0 graduates for Comprehensive sites, showing an overall maintenance of enhanced graduation rates. The same is not true for Recruiting and Targeted sites, however, which experience a net decrease of -0.4 teachers/year. While this still rounds to a net change of 0 teachers to the nearest 0.5 teacher, further decreases in future post-funding years are likely to move these graduation rates close to baseline on average. While Comprehensive sites’ graduation rates drop over time, they do not (on average) return to baseline. About 60% of Comprehensive sites sustain their grains, versus about 40% of other sites.

Comprehensive legacy sites often sustain their grant outcomes.

Report: Comprehensive II Site Sustainability Study

All but two of the 16 sites studied sustained the outcomes of the grant (e.g., leadership, structures, a strong physics teacher education (PTE) program) to some degree. All have a functional PTE program. More than half (9 institutions) are rated with high sustainability.
Teacher graduation increased by 1/year on average and this increase was sustained on average (figure to right). For those sites which experienced an overall gain in graduation rate (N=11 sites) the average increase is even higher: 2 teachers/year. Gains and graduation rates were also overall higher for sites rated as sustained, figure below.

Overall, it is remarkable how many activities and structures were maintained across sites. Sustainability plans from the grant were upheld and in all but two cases the institutional match commitment was upheld. For most areas of the PTEPA Rubric, activity maintained or increased since PhysTEC for at least 80% of sites. LA programs were maintained at 13 out of 15 sites with an LA program; PhysTEC created or helped to maintain all these programs. External funding and human resources were often reduced. The TIR position was maintained for over half of institutions usually in a regular departmental position (such as lecturer or lab coordinator). Most TIRs who were sustained included coordinating an LA program as part of their duties, demonstrating that LA programs can be an effective part of a sustainability plan, even if only indirectly related to PTE.

**Human and financial resources are strongly connected to sustainability.**

Report: Comprehensive II Site Sustainability Study

Unsustained sites lacked champions, resources, and capacity for PTE. The two unsustained sites did not have a champion, and there were also very few resources allocated to PTE (e.g. funding, people, and full time equivalent; FTE). Sites with greater levels of sustainability had generally higher levels of internal and external funding, greater numbers of PTE leaders and team members, and larger FTE of faculty time available. Local teacher salaries were not related to sustainability level, nor was the year of funding. UTeach replication sites experienced mixed sustainability results, with the Master Teacher not typically serving as a good replacement for a PhysTEC TIR.

**Sustainability increased with the number of majors and with postbac pathways.**

Report: Comprehensive II Site Sustainability Study

Future teachers represented about 10% of undergraduate majors, on average, and about half of future teachers were certified through post-baccalaureate pathways. Department size was higher
for the 9 more well-sustained sites (average 33 majors/year) compared to the less sustained sites (average 21 majors/year), and these sites also grew more (+15-16 majors/year on average compared to +8 majors/year). The percentage of majors choosing to become teachers also increased with the sustainability level (8-9% for lower sustainability compared to 10-11% for well-sustained sites). Well-sustained sites tended to include a post-baccalaureate pathway as one of the main ways in which students achieved certification, and more students graduated through these pathways than through undergraduate-only routes.

**Institutional culture is a hallmark of exemplary institutions; site capacity is necessary but insufficient for success.**

Report: Comprehensive II Site Sustainability Study

Each site was rated on their capacity and culture for PTE based on their leadership, institutional culture, and resources. All those rated as sustained were at least “medium” capacity. Thus, “medium capacity” may be a threshold for good results. Among the 9 sites that were rated as sustained, 4 were identified as truly exemplary; these were marked by stronger institutional climate and program collaboration and rated as “high capacity.” Sites that were sustained but not exemplary appear to have maintained their programs and outcomes because of the efforts of champions, rather than due to broader commitment to the cause. Thus, “high capacity” including a strong institutional climate may be needed for exemplary results. Five sites had strong capacity and strong PTE programs, but low graduation rates; these were denoted as “mixed.” Mixed sites (5 institutions) had generally good PTE programs but reduced graduation rates. These sites were typified by engaged champions but lacked supportive structure and institutional culture. When asked what helps keep things going at the site, we found that drivers of sustainability include people, money, structure, culture, and routine: The effort of champions, money, formalized structures, and culture change are critical. In many cases, having enough time to establish programmatic success enabled the establishment of value, and routines, to support continuity.

I thus conclude that:

- PhysTEC Comprehensive Sites achieve meaningful results for institutions, and the nation.
- PhysTEC supports organizational capital and a healthy ecosystem for PTE at institutions.
- It is difficult to maintain leadership, time, and effort, leading to fragility.
- Culture, including structure and routine, can help with sustainability.
- Motivated people, site capacity, and institutional culture are important, but insufficient on their own. Exemplary results require all elements of the model below to be exemplary: Motivated people, structure, and culture, likely with good connection to structures which support undergraduate education broadly.

This study resulted in a model of physics teacher education sustainability which I will discuss below in Evaluation Question 4.
Evaluation Question #4: Is the PhysTEC Theory of Change supported as a model for physics teacher educational change?

Evaluative response: The PhysTEC Theory of Change is supported; sustainability is generated through leadership, structure, and culture, and feedback loops can further support these outcomes. The PTEPA Rubric is reliable but does not show predictive validity.

The sustainability study supports a model where motivated people leverage knowledge and mitigate threats to develop culture and structure, leading to large numbers of qualified physics teachers, which reinforces those same cultures and structures. These results support the PhysTEC Theory of Change that posits the importance of structure, climate, and leadership in creating long-term impacts on teacher education. The PTEPA is generally reliable, though the “percent at least Benchmark” is more reliable than individual item ratings. Rating items is challenging giving the difficulty of determining what “counts” for certain items. While the PTEPA doesn’t predict graduation rates with current data, we will continue to test this relationship with increasingly reliable and valid data.

Sustainability requires people, culture, and structure – enhanced through self-reinforcing feedback.

Report: Comprehensive II Site Sustainability Study

Across the Comprehensive sustainability evaluation, I found strong support for a model of sustainability that demonstrates the importance of people, culture, and structure, as well as the iterative nature of change; see figure right.


Motivated people are important, but not sufficient for site sustainability; without a champion, efforts languished.
If people can generate structures and begin to establish cultures that support PTE, the success and proof of concept of the PTE program can feed back into the program’s continued success and cultural support. Both unsustained and mixed sites were hampered by severe threats, such as budget cuts and personnel loss. All sites experience threats, and some are able to mitigate those threats, and some are not. These threats are often outside the control of motivated people and are often unable to be mitigated despite best efforts and strategy. I place it within the “opportunities” bubble since opportunities and threats are often two sides of the same coin (e.g., a retirement might be an opportunity if it eliminates an intransigent faculty, or it might be a threat if it eliminates a willing champion). I found evidence that site sustainability increased overall as more elements from the model were added.

We note that this model bears some similarity to the PhysTEC Theory of Change outlined in the proposal (see next page) which highlights the importance of leadership, structure, and culture. Thus, the Comprehensive II sustainability study provided external validation for this model of change for physics teacher education but added some important elements: The added value of feedback loops which enhance success and engagement, and the importance of champions’ ability to leverage opportunities and mitigate threats.
The PTEPA is generally reliable, and results support continued use of the instrument after some revision.

Report: PTEPA Reliability Report

The Physics Teacher Education Program Analysis (PTEPA) Rubric is an instrument developed for institutions to self-assess the strength and gaps in their physics teacher education programs in areas of institutional commitment, leadership, teacher recruitment, coursework, mentoring, and assessment. To assess reliability of the results, I collected PTEPA from 35 sites which had completed the rubric on their own and had then updated the rubric based on expert guidance from myself. The study shows that 92% of items remained unchanged after expert review (on average). The percent of items rated at least Benchmark changed by only 1% on average and was thus particularly robust. However, reliability does depend heavily upon the institution/respondent, and the item and component. For the more problematic components or standards, the ratings of about 10% of items changed upon expert review. On particularly problematic items, 14-20% of sites changed their ratings upon expert review. Coding reveals that most errors arise because it is difficult to determine what “counts” for items on the rubric (either in terms of people, courses, or programs, or what is meant by the item or its levels).

Overall, the results were relatively reliable, and support continued use of the rubric for program evaluation, but with some modifications to address common areas of divergent results. This data will guide future rubric revisions in 2022. The findings that many ratings are challenging to determine without conversation with the program team and/or evaluator also supports using the rubric in conjunction with dialogue and discussion, and the use of consensus ratings as a key aspect of rubric use. Additionally, this data supports the use of “percent at least Benchmark” as a robust metric for interpreting PTEPA Rubric ratings.

The PTEPA is not predictive of graduation rates, so predictive validity is not yet supported.

Report: Regression of PTEPA and Graduation Rates

Based on PTEPA data collected from N=59 institutions, an external consultant (Dr. Remy Dou) conducted a regression analysis to determine if the PTEPA results are predictive of physics teacher graduation rates. Such a relationship would establish predictive validity of the PTEPA. The study examined whether the PTEPA predicted the existence of a change in graduation rate, the size of the change, and the number of graduates during- or post-funding. The PTEPA instrument did not predict any of these potential impacts on teacher graduation rates. Instead, teacher graduation rates prior to funding were the strongest predictor of teacher graduation rates (either during, or post-funding). Whether a site was a Comprehensive site was a significant predictor of post-graduation rates even when accounting for the pre-funding graduation rates (i.e., regardless of prior performance). Thus, being a Comprehensive site is associated with more sustainable increases in teacher graduation rates, providing statistical validation for results cited earlier in this report. Given the variability in PTEPA interpretation, we plan to use the results of the PTEPA Reliability Report to cull the data for the most reliable aspects of the PTEPA and investigate regression analyses further using that culled data. We also plan to use the more reliable “% at least Benchmark” measure of PTEPA Rubric results to determine if this variable has more predictive validity. Note that other forms of validity (substantive, content, face, and concurrent) have been established elsewhere, and areas of the PTEPA such as leadership, climate, and structure have been demonstrated to be important for sustainability – even if rubric ratings themselves are not.
Conclusions and Recommendations

In sum, I conclude that:

1. **PhysTEC activities are highly effective** for increasing graduation rates, building community and knowledge, generating durable structures, and creating proof-of-concept for physics teacher education. Comprehensive sites achieve meaningful results for institutions, supporting organizational capital and a healthy ecosystem for physics teacher education.

2. **PhysTEC activities are cost-effective and reach a variety of institutions**. The key gaps in scalability are (1) the variability in success rates of non-Comprehensive sites and (2) supporting postbac pathways.

3. **Funded site outcomes are maintained** to varying degrees but are more consistent for Comprehensive sites. The degree of positive institutional culture, leadership, and resources are related to sustainability level.

4. **The PhysTEC Theory of Change is supported**; sustainability is generated through leadership, structure, and culture, and feedback loops can further support these outcomes. The PTEPA Rubric is reliable but does not show predictive validity.

These are overall very positive results and demonstrate the impact of PhysTEC’s built expertise and community in teacher education.

The main gap areas are:

1. **Variability in outcomes** for non-Comprehensive sites (including a large fraction without gains in graduation rates, and a general return to baseline levels of graduation numbers)

2. **The need for diverse certification pathways** (e.g., postbac and undergraduate) but the lack of resources at all institutions to support all pathways.

My recommendations for the next several years of the project are:

1. **Offer both Comprehensive and non-Comprehensive grants.** Comprehensive grant outcomes are robust with good return on investment. Smaller grants are an important element of scalability of PhysTEC interventions and engage a variety of institutions.

2. **Reduce the variability in outcomes for non-Comprehensive sites** (e.g., Recruiting sites) by reducing the number of sites that do not increase the number of teachers graduated. For those who do not yet have a strong undergraduate program, provide interventions to get them there (e.g., EP3). I believe one key is to create an engaged community of practice for funded and legacy sites with working meetings (not just talking). I also believe advice and mentoring targeted to each institution and each state is key, and PhysTEC’s experience of the value of “mini site visits” to current Recruiting sites confirms this idea; such “mini site visits” might be important to continue. I also continue to believe that small grants should focus on one, transportable, sustainable intervention (like an LA program) as the target for their efforts. I have suggested
increasing the grant amount slightly (e.g., to $50K) to allow greater administration attention and structural change. Active recruitment of students is another important target, and perhaps should be the topic of conversation at least once per semester with funded sites. Lastly, I wonder if offering regional Recruiting grants (e.g., to 5 institutions in a region) would help collective action and engagement.

3. **Find ways to strategically support diverse certification pathways for** engaged institutions (i.e., postbac and undergrad). I believe PhysTEC needs to learn more about how these postbac and MAT pathways work in different areas, and what types of institutions can provide them. Smaller institutions may have more postbac certification routes. Perhaps PhysTEC could help coordinate regional hubs of institutions so that undergraduates know where they might seek this postbac certification upon graduation from an institution without one. PhysTEC has also suggested that supporting physics *minors* to consider teaching is an untapped pathway, given how few PhysTEC graduates have minors (14%).

4. **Continue to engage legacy sites** to leverage and grow these positive outcomes. Ideas we have discussed are mini-grants, mentors, and funding site attendance at the conference. I suggest monitoring graduation numbers per site on an annual basis and setting up “mini site visits” or other interventions with institutions that are languishing.

5. **Offer the conference in-person** to maintain the momentum and engagement of the community. However, continue to offer it online periodically and/or include hybrid components as this provides accessibility.

6. **Continue to monitor and direct the outcomes of regional networks** to ensure that their potential is realized. There is built potential here, but they have not yet come to fruition and will require monitoring and nudging.

7. **Find out how to address the problem of data collection.** This year PhysTEC has been challenged with many sites not submitting information on graduates, or other reporting requirements. I don’t know how to address this problem but am bringing it up as a problem to address. Accurate and timely data collection supports evaluation, but also supports the project’s ability to intervene with sites having trouble.

PhysTEC’s success is in part due to its focus on using formative assessment to improve its programs. The program has provided written responses to all evaluation recommendations this year and has indicated intentions to take up many of these ideas. One key idea from PhysTEC’s responses to the evaluation is the metaphor that it’s important to continue to put energy into the physics teacher education system at an institution to support change. The use of mini-grants and other small interventions are ways to continue site activity. PhysTEC has also taken the new Sustainability Model to heart and is using it when interacting with sites to help them improve their efforts.