Professional Evaluation and Growth Plan

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Contents

Chapter 1

Introduction

Dear Friends,

I have compiled a report on my progress as an instructor, scholar, steward, and advisor for Whittier College during the period of 2021-2022. The following is a reflection on the development of my educational and scholarly practices, and the service I have performed for the College as a mentor, advisor, and committee member. I strive to perfect my teaching abilities, and I am pleased to report that my students are learning and growing at Whittier, and achieving success in the professional world. In our last communication, after my second major PEGP report (delayed to the fifth year due to the pandemic), you asked me to reflect on my pedagogical practices. In particular, you suggested four concrete topics on which I could reflect. First, you asked me to describe my interpretation of the learning process. Second, you asked me to describe how I incorporate tools and practices in my courses. Third, you asked me to describe how the tenets of my teaching philosophy help us to achieve the learning objectives that we set for our courses. Finally, you asked me to focus on the *why* behind specific teaching decisions as opposed to the *how*. You also posed similar questions about the *learning focuses* that I have provided in the past.

With these four simple questions in mind, I have taken what I think is the most straightforward and concise approach to the structure of my teaching philosophy in Sec. 2.1. I reflected on what practices I actually use most often in my teaching, and answered each of the four questions for all practices. This exercise has been useful and enlightening, as it has encouraged me to think carefully about how the central principles of *order* and *shared meaning* are reflected in the subject of physics, and the instruction of physics. It is my hope that this exercise provides you with useful insight into modern physics instruction. I have also reflected on the *learning focuses*. These ideas were derived originally from my colleagues in my department, but I have since modified them and made them my own. In reflecting on how I conduct my courses, I have come to the conclusion that the learning focuses simply guide my course creation and course content selection. How I conduct my courses, and the *why* behind specific teaching decisions I make are driven primarily by the tenets of my teaching philosophy. Though my teaching practices continue to generate positive student feedback in the form of strong student evaluation scores, I have also identified areas of courses that need to be adjusted.

Turning to my scholarship, I have many new and exciting accomplishments to share with you in Sec. xxx. Three recent experiences come to mind as examples. First, I have finally published in *Physical Review D,* the flagship peer-reviewed journal in my field by the American Physical Society (APS)[1]. As far as I can tell, I am the first professor at Whittier College to achieve this. This publication was the culmination of two years of work with an undergraduate student who has become a dear friend. This result marks the first time a professor from my department has published in one of the *Physical Review* journals in the last 16 years[2]. The piece provides the first fully analytic model of Askaryan radiation. I hope to make clear why the results represent a significant contribution to my field, and how my undergraduate researcher helped me to improve and finish this work (see Sec. xxx, and also Sec. 3.3.2 of my previous PEGP).

The second experience pertains to my radio-frequency (RF) engineering and radar research with the Office of Naval Research (ONR). In 2021, I published a paper involving the computational electromagnetism (CEM) of radar design[3]. This work was ranked Top 10 Most Notable Articles in Electronics Journal for six months. The work caught the attention of CEM experts from four different countries who each contacted me for advice and collaboration. This Summer, I was invited to speak at a CEM conference held at MIT. I gave a 45 minute lecture on open-source RF CEM design alongside colleagues from MIT, Google, Georgia Tech, Stanford, and BYU. It was an incredibly meaningful

[1] J.C. Hanson and R. Hartig. "Complex analysis of Askaryan radiation: a fully analytic model in the time domain." Phys. Rev. D **105**, 123019 (2022).

[2] See, for example, S. Zorba *et al.* "Fractal-mound growth of pentacene thin films." Phys. Rev. B **74**, 245410 (2006).

[3] J. C. Hanson. "Broadband RF Phased Array Design with MEEP: Comparisons to Array Theory in Two and Three Dimensions." Electronics Journal **10**, 415 (2021).

moment in my career. I took the opportunity to promote the mission and values of Whittier College to our peers at these institutions. Having received an ONR Summer Faculty Research Program (SFRP) grant for the third year in a row, I am eligible for ONR Senior Fellowship in Summer 2024 after a mandatory one-year break. For the past two years, our ONR partners at NSWC Corona Division have granted us money and precision RF equipment to boost the engineering research experiences of our students. Based on this fruitful collaboration, I'm happy to share that they would like to form an Educational Partnership Agreement (EPA) with Whittier College. NSWC Corona forms EPAs with colleges througout Southern California in order to strengthen undergraduate engineering research, and to recruit engineering talent. Including Whittier College students in this endeavor will be wonderfully beneficial for our students.

The third and final experience is related to both my scholarship and teaching. In Fall 2019, I taught INTD255, entitled "Safe Return Doubtful: History and Current Status of Modern Science in Antarctica" (CON2). In Spring 2021, I taught INTD290, entitled "A History of Science in Latin America" (CON2,CUL3). I concluded these courses with material related to the connection between modern scientific endeavors by peoples of diverse cultures and exploration literature. I showed the students how it is possible to travel to Antarctica through the United States Antarctic Program (USAP). As part of my research with the IceCube Gen2 collaboration[4], I have conducted research expeditions to Antarctica through USAP. Thus, there is a deep connection between my teaching and research via the concept of exploring the unknown. A long-time goal of mine has been to inspire my students to begin their own careers in science and in life with the same organization, mental discipline, curiosity, and confidence required of any explorer. I am thrilled to report that we are finally sending our first Poet undergraduate to Antarctica. Scout Mucher, who was my student in INTD290, was inspired to go, and we met to go over the application process in detail. Scout was hired as a contractor to help run USAP operations in McMurdo station, our flagship base on Ross Island. Scout has now PQ'd (physically qualified), and is slated to begin work there when the sun rises this Fall! I am so proud of Scout, who will become the first Whittier Poet to set foot on Antarctic shores.

For my service to Whittier College for the 2021-2022 academic year, I joined the Educational Policy Committee (EPC). I had been in discussions with Prof. Rehn about joining the Whittier Scholars Program (WSP) advisory board. Near the end of Spring 2021, I was called to first serve for a year on EPC, and I answered the call. The major task for EPC was to generate consensus around a revised course system proposal to be brought before the full faculty by the end of the year, in light of proposed changes to faculty load. While discussions of the course system and faculty load proposals continued, we also completed a long list of other tasks. These included studying and approving changes to ten major programs and changes to programming within the Center for Engagement with Communities (CEC), raising student per-semester credit limits, revising the definition of a credit hour, revising the new course proposal form, revising handbook language pertaining to syllabi, and to study the use of "tracks" or "emphases" within major programs at Whittier College.

I led a sub-committee dedicated to the study of tracks and emphases, and our goal was to develop a common language for tracks across campus. I framed the task by comparing "tracks" and "options" to *partitions*, as a computer hard drive is partitioned. We examined data from Whittier College websites and DegreeWorks to accurately determine the number of partitions per program. I found that, on average, major programs at Whittier College have two partitions per major. Rounded to integers, the natural sciences tend to have three partitions, while the social sciences and humanities tend to have two. The variances, however, are large. We used this diverse data set to formulate a survey we sent to department chairs. The data set and chair responses will be used to formulate common policy for tracks and options within majors. For example, students might find it useful to have a common language describing options within majors to improve understanding of the curriculum.

With regards to the course system, I tried my very best to aid in the discussions by thinking through the technical implications of each tenet of the proposal. One example of how I helped to advance the discussion was to offer a compromise between two positions regarding the maximum number of courses per semester. One one hand, some wanted to limit first-year students to just four courses per semester, and require all students to obtain special permission to take five courses in any semester. On the other hand, some objected to any course restriction. I describe the compromise position I devised in Sec. xxx. We ultimately adopted this compromise into the final proposal. This episode in my committee service demonstrates that I do have the capability to build consensus, even when the task is technically challenging. I give much credit to my colleagues on EPC, and especially co-chairs Profs. Camparo and Householder, for setting such a good example from which I can draw useful experience. In Sec. xxx, I describe ways in which I might be of service to Whittier College in the future, given my reflections on my accumulated committee service. Often, I find ways to aid with technical discussions by writing code and crunching numbers that add weight to our policy discussions. Thus, I propose to help with institutional research, and provide a few ideas in Sec. xxx.

In Sec. xxx I describe my accomplishments in advising and mentoring. In our last communication, you gave concrete

[4]See, for example, `https://icecube.wisc.edu/`.

suggestions for my writing and reflection in this area. Specifically, you asked me to expand on my philosophical approach to advising and mentoring. You shared a concern that my advising leads students down a rigid path, and that creating digital profiles using services like LinkedIn narrows their outlook. You also shared that you would prefer a self-reflective approach to the advising and mentorship section, rather than a step-by-step guide. I have responded by reflecting on my advising and mentorship much more succintly than my previous PEGP report. I describe how I employ a philosophical perspective that motivates my students to take charge of their future in a way that is useful for them and in alignment with their values and interests. I have also included tangible results of successful student outcomes, such as internships, publications, and fellowships gained by my advisees. I also discuss in Sec. xxx plans for taking first-year advisees again this year, and my new section of INTD100. I think you will find my topic selection for my INTD100 advisees particularly useful given the current cultural climate.

To your point about rigidity, I'm surprised that the counter-examples I provided in my last report did not ameliorate your initial reaction. I do retain flexibility in my approach to advising, and I gave an example as proof. I had an advisee who initially decided on majoring in physics, but realized in the midst of our discussions that his path lies in a different direction. After appropriate reflection, we decided to change his major to Digital Art and Design (see Sec. 5.2.1 of my previous PEGP). In Sec. xxx, I share how the decision tree I provided (also in Sec. 5.2 of my previous PEGP) is not just something I invented, but actually reflects the thinking of many majors in the physical sciences. I have infused this decision tree with more detail about the diverse paths my students take towards their career goals. I also point out in Sec. xxx that our recent curricular discussions include the creation of digital portfolios and encourage sharing senior theses in Poet Commons. Our advisees will share these with potential employers, and use them to draw connections between projects at Whittier College and their future plans. Tools liked LinkedIn are a widely accepted mechanism to facilitate sharing work. It is fruitful to encourage students to use these tools to take control of their job search, and to refine and even reverse-engineer the search given their digital portfolio. Finally, I note that I will serve on the WSP advisory board this coming academic year. My advising of current WSP students, WSP advisory board participation, and recruitment for the program all serve as evidence that my advising and mentorship is closer to the *opposite* of rigid. The very nature of WSP is to foster academic exploration in interdisciplinary and flexible settings. In Sec. xxx, I describe my latest advising effort with my current WSP student, and future plans for new WSP students.

In Sec. xxx, I describe a project regarding equity and inclusion within the natural sciences at Whittier College. Back in 2017, I had the idea to create an app that would facilitate inclusion in introductory physics courses infused with machine learning to tailor the user's experience. I named the idea "The Primer," in reference to a sci-fi novel in which a young woman aquires a tool that accelerates her education through a narrative tailored to her background and past success in science. The visual environment and narrative of the app was to be designed by diverse Whittier College undergraduates so as to make the experience as inclusive as possible. I finally found time to encapsulate this idea into an internal DEI grant (submitted and approved by the Inclusion and Diversity Committee). The IDC members suggested I attend three workshops on inclusivity in introductory STEM courses given by the Cottrell Scholars Network. (Some of these workshops were later suggested to all departments by the Dean). In these workshops, we learned about current psychological research within the field of inclusion in introductory STEM courses. It is my hope that one of my current advisees in computer science, who comes from a diverse background, can help me create and test the code for this app over the coming year. I will begin to recruit digital designers this Fall semester from within Whittier College to develop the digital storytelling aspect of the tool. We hope everyone will enjoy the results!

My friends, it is my hope to be granted tenure at Whittier College. I hope that the effort and passion I have given to our institution for the past several years merits this distinction. I have created and taught new courses that students have enjoyed and found useful, including liberal arts courses that fused my research interests in the natural sciences with social issues and history. I have demonstrated tangible successes in the areas of scholarship of discovery and application, and the the future holds several exciting research avenues to explore with our students. I have served on multiple committees that have tackled complex issues ranging from student admissions data to the course system proposal. I have continued to be a resource as a first-year advisor to many new Whittier Poets, and I have a track record of leading majors in the physical science to successful career outcomes. All the while, I have done my best to incorporate your suggestions made with professional candor into my work. I speak for myself and my department when I say that we are grateful for the work that you do, and we trust in your insight and wisdom.

Sincerely,
Jordan C. Hanson
Assistant Professor, Dept. of Physics and Astronomy

Chapter 2

Teaching

I have reflected on my overall teaching practice for the academic year (AY) of 2021-2022. In Sec. 2.1, I respond to your questions in our last communication regarding my teaching philosophy. In Sec. 2.2, I reflect on the introductory physics courses I taught in AY 2021-2022. In Sec. 2.3, I analyze the course evaluation data from these courses and reflect upon the student feedback. In Sec. 2.4, I reflect on the advanced physics courses I taught in AY 2021-2022. In Sec. 2.5, I analyze the course evaluation data from these courses and reflect upon the student feedback. I list several interesting ideas for modifying PHYS306/COSC330: Computer Logic and Digital Circuit Design, including further integration with COSC360: Digital Signal Processing.

2.1 Teaching Philosophy: Six Easy Pieces, Derived from the Order and Shared Meaning of Physics

I have reflected on the teaching practices I have used in light of the four suggestions I received in our last communication. What follows is a reflection on the six main teaching activities I use in the physical sciences. Many of these practices also apply to my liberal arts courses and college writing seminars, but not all of them. Each activity is derived from the over-arching principles of *order* and *shared meaning.* However, I have chosen not to cover those principles in detail, since I have already shared that in Sec. 2.1 of my prior PEGP. Instead, for each of my six main teaching activities, I briefly articulate how they flow from *order* and *shared meaning.* Next, I answer the following four questions you posed.

- (a) *For this teaching activity, can you describe your interpretation of the learning process?*
- (b) *For this teaching activity, how do you incorporate teaching tools and practices?*
- (c) *For this teaching activity, can you show how the tenets of your teaching philosophy help achieve learning goals you set for your courses?*
- (d) *For this teaching activity, can you focus on the "why" of specific teaching decisions, instead of "how?"*

After completing this exercise, I reflect upon where I might make changes going forward, and which pieces seem to be working well. One interesting shift that has taken place within our department is the use of *online laboratory activities.* I reflect on *why* we have incorporated this practice during the pandemic and going forward.

2.1.1 General Approach: How I Teach with Six Easy Pieces (1-6)

I begin by reflecting on my teaching philosophy for introductory physics courses. The most succinct expression of my teaching philosophy may be broken into the six main teaching activities, or ingredients, below. As I shared in Sec. 2.1 of my prior PEGP, physicists tend to classify students into *majors* and *non-majors.* The broadest definition of a *major* student is a student requires at least some physics or engineering courses above the introductory level. Most physics education research (PER) is done in the context of courses designed for *non-majors.* PER provides empirical evidence for *why* teaching practices are effective. Most students who take physics and engineering courses at Whittier College are non-majors. Thus, most of the energy I devote to my teaching philosophy focuses on application to introductory courses. When I teach advanced physics and engineering courses, I simply use the same ingredients with a different recipe. Advanced physics and engineering courses are built from introductory ones, so students in those courses have already had the first rendering of ingredients (1-6) and are ready for something new. When I teach liberal arts courses and sections of college writing seminar, I use a subset of activities (1-6), augmented by writing assignments.

I begin introductory course sessions with teaching activity (1): traditional lecture format. I start with a warm-up exercise drawn from textbook readings assigned 1-2 days prior. Before giving the solutions, I present a thorough agenda for the session. I then solve the warm-ups as on the whiteboard, and build on them with more intricate examples and proofs of theorems. Next, I usually proceed to ingredient (2): peer-instruction [1]. I pose conceptual multiple-choice questions to the students, based on activity (1). Students record their anonymous answers electronically, and we view the answer distribution. We discuss our responses as peers in small groups, and I search for students who appear to be struggling and help stimulate their thinking by re-phrasing the question or giving them clues. The students give a second response, and we move forward when a super-majority of the students get it right. Next, we arrive at activity (3): PhET simulations. As the systems we study grow more complex, it is useful to simulate them. Physics education technology, or PhET [2], consists of HTML5 applications designed using extensive PER. I provide written activities the students must complete while operating the simulation.

I use the second half of our session to conduct a laboratory activity, ingredient (4). We work as a team in our department to maintain consistent lab pedagogy and equipment. The students complete labs that cover the same content presented in activities (1)-(3) during class sessions. Sometimes activity (5) becomes possible, in which we cover lecture content that is testable in both a PhET and a lab. We align theoretical predictions with simulation and lab experiment[1]. The students perform activity (6) near the end of the semester, when they propose, build, execute, and present experiments as small groups to the class. Teaching activities (1)-(6) represent the *average* recipe for my courses. As a cookbook contains a diverse collection of healthy recipes using common ingredients, I mix these ingredients in new and interesting ways to avoid repetition and maintain student engagement.

2.1.2 (1) Traditional Lecture Format

My reflections provide three facets **(i)-(iii)** that make traditional lecture useful for students. **(i)** Solving problems on the whiteboard **displays the components of physics** in step-by-step fashion. These components include variables, estimation, units, functions, algebra/calculus, solutions and graphs, and checking results by examining units, limiting cases, and symmetry. Facet (i) is derived from the principle of *order,* in that statements about the natural world must be ordered using consistent terminology and mathematics. **(ii)** Traditional lecture gives the students **memorizable examples** that serve as concrete anchor points, and it is a form of *shared meaning.* Our mutual understanding of a system is assured, and students use them to solve problems that share traits with the example. **(iii)** By **linking basic examples together**, students begin to solve harder problems for more complex systems. Because complex physical systems in physics may be reduced to sub-systems we already understand, the students experience the intrinsic *order* of physics and use it to model complex systems.

Facet (i): displaying the components of physics problem solving.

(a) *For this teaching activity, can you describe your interpretation of the learning process?* As with any subject, students must first understand how to use its components before solving problems or creating something new using those components as one. One example that arises every Fall semester in my courses is the usage of physical units with variables. If the students are solving for the final speed of a system, some will write "the final speed is 12." My next question is always "twelve what? Kilometers per hour, feet per second ..." By giving explicit examples, students become aware that there are components of physics calculations they do not yet understand. The students learn from this activity by following our example. Once students master concrete examples, they can adapt them to model similar systems.

(b) *For this teaching activity, how do you incorporate teaching tools and practices?* While traditional lecture content is considered old-fashioned in PER, solving a problem with nothing but a piece of chalk in front of a group of students will always have a place in my teaching. As long as I provide a written warm up for the students, solving it in front of them gives them an anchor point that can be copied and studied. I have also learned to control the *pace* of this content, to maximize the learning of a diverse group of students.

(c) *For this teaching activity, can you show how the tenets of your teaching philosophy help achieve learning goals you set for your courses?* Two relevant learning goals[2] set for my recent two-semester sequence of algebra-based physics are (A) To solve word problems pertaining to physics and mathematics, and (B) to construct mathematical models of mechanical systems. Facet (i) of traditional lecture addresses (A) by breaking down a word problem into its components, while translating the words into mathematical statements. This is especially useful for students who grew up in a bilingual setting. Facet (i) of traditional teaching addresses (B) because I demonstrate how harder problems can be broken into more manageable components.

[1] Ideally, we would do this every time, but there are not yet PhET simulations for all labs.
[2] Learning goals are always listed in my course syllabi. See supplemental material for details.

(d) *For this teaching activity, can you focus on the "why" of specific teaching decisions, instead of "how?"* The most basic reason that comes to mind is that the students ask for it. It's concrete, and feels right to them. Even if more modern PER methods are shown to be effective, I have learned that a course with too little of facet (i) is disorienting to learners.

Facet (ii): memorizable examples.

(a) *For this teaching activity, can you describe your interpretation of the learning process?* On a basic level, the learning process includes memorization and repetition, similar to the way a new student of music or a new language learns. Compare the way someone who speaks English begins to learn Spanish, as opposed to *linguistics.* Memorization and repetition plays a stronger role in the former. Compare a new student of the guitar learns music to a student of *musical theory.* Repetition and memorization again play a stronger role in the former.

(b) *For this teaching activity, how do you incorporate teaching tools and practices?* At a minimum, once per class session, I provide a written handout (the warm up problems) that I work as examples. The students then have completed example problems they take home for study. Students also take notes as I solve further problems, or elaborate with a proof of a theorem. I also think very carefully about selecting problems for homework and exams, knowing that they must have some connection to the example base I've given to the students.

(c) *For this teaching activity, can you show how the tenets of your teaching philosophy help achieve learning goals you set for your courses?* Facet (ii) addresses learning goal (A) above by demonstrating specifically how the words of a problem lead to the actions we take to solve it with mathematical reasoning. When examples are memorized, problems involving similar logic with different numbers can be solved with ease[3]. Facet (ii) addresses learning goal (B) by providing providing memorizable models of simple systems that can be combined to build mathematical models.

(d) *For this teaching activity, can you focus on the "why" of specific teaching decisions, instead of "how?"* In a practical sense, the fact I make these examples memorizable for the students helps them with their homework, studying for exams. The confidence of the students who find physics intimidating is boosted. I recall a time I saw my student Deninson Cortez-Cruz stapling together all of my warm up problems. I remarked that it looked like his studying was going well, and he replied: "Oh yes, professor. This packet is like my Bible." I smiled, because I knew that he was going to use those resources to help his lab group ace the class, and they all did.

Facet (iii): linking basic examples together

(a) *For this teaching activity, can you describe your interpretation of the learning process?* One obvious part of the learning process for technical subjects is that an understanding of complex systems comes after understanding simpler ones. For example, suppose I have already covered the topics of *friction* and *momentum transfer*, with basic examples provided for each. The students know how to predict the deceleration as the car slides against friction. They also understand how to predict the velocities of objects that collide. If I ask them to predict the final velocity of a vehicle *struck by* another that had been sliding, facet (iii) is *why* they can solve this problem. The wrong approach would be to teach them about friction, then momentum transfer, and conclude that they should be able to solve the harder problem because they know the underlying concepts. Rather, *why* facet (iii) is so important is that the students learn how to couple simple ideas into complex ones.

(b) *For this teaching activity, how do you incorporate teaching tools and practices?* Towards the end of traditional lecture time in class sessions, I occasionally link two basic examples or concepts together to solve a harder problem for the students. When appropriate, I assign *challenge problems* for bonus points that link together three or more basic concepts.

(c) *For this teaching activity, can you show how the tenets of your teaching philosophy help achieve learning goals you set for your courses?* One could argue that the purpose of facet (iii) of traditional lecture is precisely to address learning goal (B): to construct mathematical models of mechanical systems. This is a learning goal for all of the introductory physics courses, and it does not come easily to non-majors without dedicated training.

(d) *For this teaching activity, can you focus on the "why" of specific teaching decisions, instead of "how?"* I would compare this part of the process to a piano student first learning scales before beginning to compose songs. Once students understand the *order* built into physics, they trust that connecting simple models together to form complex ones is a strategy that works. Though facet (iii) is the most challenging within traditional lecture, it is worth the payoff as the problem-solving capability grows more powerful as a result.

[3] Sometimes such collections of word problems are called "homomorphic."

2.1.3 (2) Peer-Instruction (PI)

My reflections provide three facets **(i)-(iii)** that make peer-instruction useful for students. Students must **(i) form an argument in their own scientific language**, which relates to the principle of *order* because they order the concepts of physics in their minds to achieve this. Students must then **(ii) practice explaining concepts to others.** Peer-instruction natural connects to *shared meaning* via facet (ii). Finally, peer-instruction enables **(iii) teaching efficiently.** Finally, peer-instruction has built-in pace control that keeps students engaged[4].

Facet (i): forming an argument in one's own scientific language.

(a) *For this teaching activity, can you describe your interpretation of the learning process?* Critical to the learning process in technical subjects is the ability of a student to practice absorbing abstract ideas in their minds in a way that they understand, and later confirming their understanding with peers. Peer-instruction relies on short, conceptual word problems posed in a multiple choice format. These problems reveal cases in which a student is getting correct answers but for the wrong reasons. We ask the students to explain the problem to themselves in their own words while removing the added confusion of dealing with the numbers and formulas specific to the current problem. Practicing facet (i) of PI causes students to confront their lack of understanding of a concept, and to gain control over it in a way that is practical for them.

(b) *For this teaching activity, how do you incorporate teaching tools and practices?* Since PI is such a well-studied technique in PER, I refer the reader to Appendix A, Sec. 7.2 of my prior PEGP, and the following books, websites, and conference resources [1, 3, 4],

(c) *For this teaching activity, can you show how the tenets of your teaching philosophy help achieve learning goals you set for your courses?* The relevant learning goal (taken from my introductory course syllabi) is (C): to apply logical thinking to conceptually-posed physics problems.

(d) *For this teaching activity, can you focus on the "why" of specific teaching decisions, instead of "how?"*

2.1.4 (3) PhET Simulations

things

2.1.5 (4) Laboratory Activities

things

2.1.6 (5) Synergies

things

2.1.7 (6) Student-Designed Final Projects

things

2.1.8 Outlook

2.2 Introductory Course Descriptions

The introductory

Algebra-based physics (135A/B). Algebra

2.3 Analysis of Course Evaluations: Introductory Courses

17-25 pertain to the professor.

[4] I don't find that this benefit of peer-instruction relates to *order* or *shared meaning*, but it is important enough to include here.

Algebra-Based Physics

2.4 Advanced Course Descriptions

My advanced

2.5 Analysis of Course Evaluations: Advanced Courses

The course evaluations

Computer Logic

things

Chapter 3

Scholarship

Whittier College faculty classify scholarship using the *Boyer* model... My scholarship primarily falls within two categories: the scholarship of discovery, and the scholarship of application.

3.1 IceCube, Cosmic Rays, and Neutrinos from Deep Space

Cosmic rays are

3.2 Invitation to Become a Member Institution of IceCube

Recently,

3.3 Ultra-High Energy Neutrino Research with IceCube Gen2

In the following five

3.3.1 Computational Electromagnetism

Askaryan signals

Beyond Ray-Tracing: Open-Source Parallel FDTD Methods

I have received three *Summer Faculty Research Internship grants* from the Office of Naval Research (ONR).

Connection to Teaching and Academic Mentorship

We always attempt

3.3.2 Mathematical Physics

In 2015

Frequency-Domain Model

Missing

Time-Domain Model

There are four main advantages of analytic time-domain models

The

Connection to Teaching and Academic Mentorship

Researching mathematical physics

3.3.3 Firmware, Software, and Hardware Development

Askaryan-

The Multi-Mode Frequency Counter (MMFC) and ARIANNA

My student, John Paul Gómez-Reed and

Future Plans and Applications

To continue this

Connection to Teaching and Academic Mentorship

There are important connections

3.3.4 Open-source Antenna Design

The MEEP-based phased array design technique has generated enthusiastic feedback

Connection to Teaching and Academic Mentorship

Creating RF antennas requires

3.3.5 Drone Development and The Whittier Scholars Program

A gap exists in Askaryan-based UHE-ν science.

The Open Polar Server Data Gaps, and Drones

The Open Polar Server (OPS)

Connection to Academic Mentorship and the Whittier Scholars Program

While guiding Nicolas through the WSP program, I had a great experience working with Dr. Andrea Rehn and the WSP team. I have offered to serve on the Whittier Scholars Advisory Board, and my offer has been accepted.

3.4 Collaborations with the Office of Naval Research

During 2019-2020, it became clear that not only were missions to Antarctica postponed, but that progress in my field will only resume once the IceCube Gen2 design is finalized.

I have been awarded this ONR Summer Faculty grant

3.4.1 Computational Electromagnetism and Open-Source Radar Design

In Sec. 3.3, I described how *phased arrays* will be useful for UHE-ν physics.

First, I believe my work represents the first time it has been shown MEEP can produce RF phased array designs.

3.4.2 3D Printing of RF Antennas

This summer, my ONR colleagues and my student, Adam Wildanger, and I have begun fabricating

3.4.3 Applications to Mobile Broadband

There are a variety of applications for this research. Progress in high-gain ultra-wideband radar development is hindered because desireable parameters compete with each other. The authors

According to an economic analysis by the Los Angeles County Economic Development Corporation in 2016

3.5 Building Student Success after Whittier College

When I began to interact with the Office of Naval Research, my contacts raised the possibility of a more formal partnership with Whittier College.

To date, I have advised five physics and engineering students toward graduation (not counting my WSP student)[1] Three of them are attempting

3.6 Equipping Whittier College Laboratories

My colleagues at NSWC have already provided our laboratory in SLC with equipment

3.7 Financial Support

From Tab. ... I can receive \$16.5k per summer as a Summer Faculty Research Fellow through ONR. At the next level, Senior Fellows receive \$19.0k per summer. To qualify for Senior Fellow, one must have been awarded tenure as an Associate Professor at an institution accredited by the U.S. Department of Education. One also must have published one paper per year since receiving a doctoral degree. If awarded tenure in academic year 2022-23, I would meet both requirements for the 2024 application round. Regarding sabbatical, the ONR does have another program designed for professors to complete research projects while on sabbatical for 1 or 2 semesters. This funding is important for my family, and we are proud to work hard for Whittier College and our students as they help serve ONR. Regarding student financial support, I am hoping to coordinate that this year as a team effort between Whittier administrators and ONR personnel.

3.8 Conclusion

Since my last supplemental PEGP in 2019, my students and I have made wonderful progress, and I am proud of them.

1. J.C Hanson *et al.* “Observation of Classically Forbidden Electromagnetic Wave Propagation and Implications for Neutrino Detection.” Journal of Cosmology and Astroparticle Physics, n. 7 p. 55 (2018). `doi:10.1088/1475-7516/2018/07/055` *and* C. Glaser *et al.* “NuRadioMC: simulating the radio emission of neutrinos from interaction to detector.” The European Physical Journal C, vol. 80 n. 2 p. 77 (2020). `doi:10.1140/epjc/s10052-020-7612-8`

2. J.C. Hanson. “Broadband RF Phased Array Design with MEEP: Comparisons to Array Theory in Two and Three Dimensions.” Electronics Journal, vol. 10 n. 4 p. 415 (2021). `doi:10.3390/electronics10040415`

3. J.C. Hanson and R. Hartig. “Complex Analysis of Askaryan Radiation: A Fully Analytic Model in the Time-Domain.” *Accepted to Physical Review D.* `arXiv:2106.00804` (2021).

The papers in item (1) deal with the

Thankfully, my field has recovered from the turmoi

[1] Students: Cassady Smith, John Paul Gómez-Reed, Nicolas Clarizio, Nicolas Bakken-French (WSP), Raymond Hartig, and Adam Wildanger.

Chapter 4

Service

A key part of our

4.1 Committee Service

In 2017, my department had arranged my schedule such that I did not serve on a committee for the first year. By Fall 2018, I had developed the idea that I could serve Whittier College through data analysis. I was interested in the connection between the high school preparation of our students and their ability to pass introductory courses required for their major. On the Enrollment and Student Affairs Committee (ESAC), in Fall 2018, I learned that this is a topic with which many administrators and intructors had been struggling. I spent two years working on ESAC, and I watched as our committee carefully approached consensus while remaining respectful of the diverse perpectives that included athletics, student life, and instructors. In the second year, we began discussions with Falone Serna, Vice President of Enrollment Management, to implement the policy result of the prior year. On ESAC, I also learned about first year orientation, for which I volunteered in 2019 and 2020.

In 2020-21, having served two years on ESAC, we decided it would be good for me to experience service with other types of committees.

4.1.1 Educational Policy Committee

My sub-project, the survey. Framing the issue of the course system, understanding it. Mathematical analyses of the proposals: (a) financial implications (b) pedagogical implications (c) curricular implications (d) the compromise i offered that was accepted regarding maximum course loads

4.1.2 The Whittier Scholars Program

Another year, another advisee, acceptance to join the WSP board

4.1.3 Future Proposals for Institutional Research

Full utilization of the Tableau dashboards left by Gary Wisenand, growth of the ICS/Math major etc.

4.2 First Year Orientation

In the Fall of 2018, I was invited by Prof. Seamus Lagan to help with the first-year orientation.

The second mentoring experience in 2020 occurred during the height

4.3 Open Educational Resources (OER) Workshops

I was invited to give two lectures at OER workshops

The OpenStax Tutor system

In my OER lectures, I also gave examples of OER usage in advanced courses.

4.4 Center for Engagement with Communities: The Artemis Program

In Sec. ..., I wrote about my experiences serving the Artemis program. To avoid covering the same ground twice, I give just a simple summary of the facts here.

Chapter 5

Advising and Mentoring

I reflect on my role as an advisor and mentor at Whittier College below.

5.1 Connections to Teaching, Advising First-Year Students

Advising and mentoring students resembles our teaching practice, because we must create a sense of *order and shared meaning* in the mind of the student surrounding the curriculum.

Physics professors often classifiy students into two broad categories: *non-majors* and *majors* (see Sec. 2.1). Most of our advisees as teachers fall into the first category.

Advising non-majors follows a basic progression: introducing them to the curriculum and campus (*order*), beginning a conversation surrounding major selection (*shared meaning*), and future course selection.

5.2 Advising and Mentoring First Year Students

A

5.2.1 First Year Advising, by the Numbers

B

5.2.2 Navigating the First Year

C

5.2.3 Discernment of Major

D

5.2.4 Equity of Access

E

5.2.5 Inclusion and Belonging: Activities with First Year Advisees

5.3 Advising and Mentoring Majors in Physics, ICS, and 3-2 Engineering

After reflecting on my advising practices with my STEM students, I realized that there is an implicit decision-tree that lives in my mind (see Fig. 5.1).

Semester	**Number of First Year Advisees**
Fall 2019	15
Fall 2020	14
All semesters	**Physics, ICS, and 3-2 Majors**
	Cassady Smith (Physics '20)
	John Paul Gómez-Reed (Math/ICS '21)
	Nicolas Clarizio (Physics, Business Admin. '19)
	Alex Ortiz-Valenzuela (3-2 Engineering/Physics '22)
	Raymond Hartig (Physics and Math '23)
	Adam Wildanger (3-2 Engineering/Physics '21)
	Matthew Buchanan Garza (ICS/Physics '23)
	Natasha Waldorf (ICS/Physics '24)
All semesters	**Whittier Scholars Program Majors**
	Nicolas Bakken-French (WSP '21)

Table 5.1: A summary of my advisees, broken into three categories: first-year advisees, STEM majors, and WSP majors. There are some first year advisees who have chosen ICS/Math for their major, for whom I remain a mentor. One example is Emily List (ICS/Math '23).

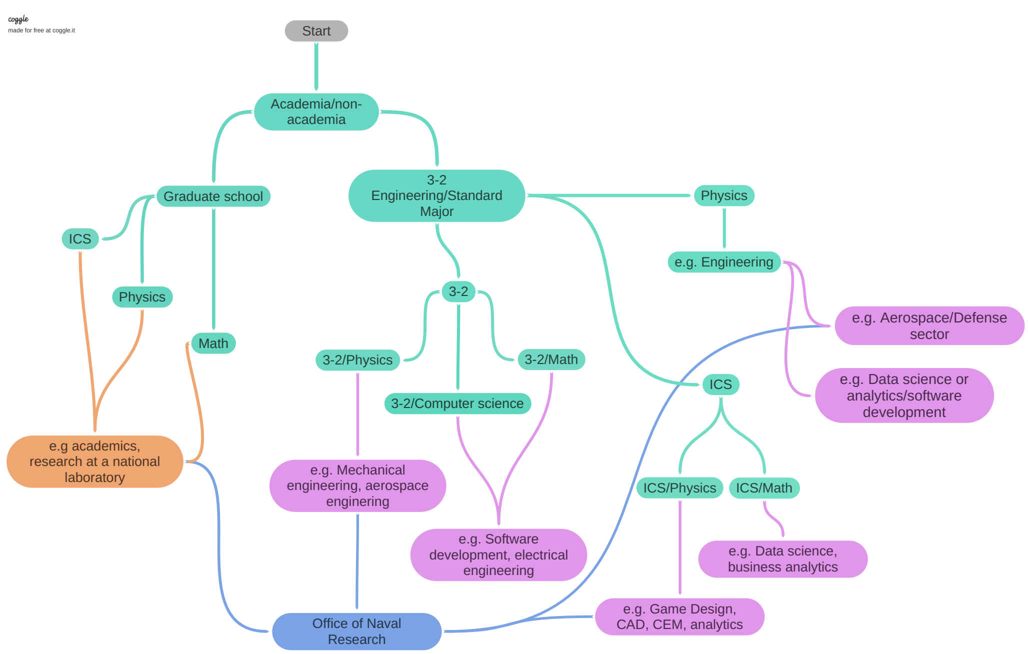

Figure 5.1: A decision-tree that orders my thinking around the advising of my STEM students.

5.3.1 Discernment within STEM: Major Selection, and Diverse Pathways to Graduation

Discernment means the ability

5.4 Advising and Mentoring Whittier Scholars Program Majors

I have had a wonderful time recruiting students for the Whittier Scholars Program. There are two moments that stand out for me. The first happened when I accompanied Nicolas Bakken-French to his final meeting with Profs. Rehn and Kjellberg,

Now mention Jackson Diamond, and the connection between WSP and computer science

Chapter 6

Conclusion

This semester marks the beginning of my sixth year with Whittier College. These years have been filled with both wonderfully uplifting experiences, but also sacrifice. I hope that my writing

Respectfully submitted, Jordan C. Hanson

Chapter 7

Appendix: Supporting Materials

A simple listing of supporting materials referenced throughout the report is given below.

1. **Previous Letter from Faculty Personnel Committee**
2. **Letter from Department of Physics and Astronomy**
3. **Curriculum Vitae**
4. **Course syllabi**
   (a) PHYS135A: Algebra-based physics 1
   (b) PHYS135B: Algebra-based physics 2
   (c) PHYS150: Calculus-based physics 1
   (d) PHYS180: Calculus-based physics 2
   (e) PHYS306/COSC330: Computer Logic and Digital Circuit Design
   (f) PHYS330: Electromagnetic Theory
   (g) COSC360: Digital Signal Processing (DSP)
   (h) INTD100: College Writing Seminar
   (i) INTD255: Safe Return Doubtful: History and Current Status of Modern Science in Antarctica
   (j) INTD290: A History of Science in Latin America
   (k) MATH080: Elementary Statistics
5. **Course Evaluations** (each corresponds to courses listed above)
6. **Published Papers**, lead author
   (a) "Observation of classically 'forbidden' electromagnetic wave propagation and implications for neutrino detection." JCAP (2018).
   (b) "Broadband RF Phased Array Design with MEEP: Comparisons to Array Theory in Two and Three Dimensions" Electronics Journal (2021). Results from this paper also published in the Proceedings of the International Cosmic Ray Conference (ICRC) 2021.
   (c) Two notices from Electronics Journal indicating the above paper was in the Top 10 Most Notable articles in the journal in 2020-21.
   (d) "Complex Analysis of Askaryan Radiation: A Fully Analytic Model in the Time-Domain" (Phys. Rev. D) 2021.
7. **Other Papers**, contributed but not the lead
   (a) "A search for cosmogenic neutrinos with the ARIANNA test bed using 4.5 years of data." JCAP (2020).
   (b) "NuRadioMC: simulating the radio emission of neutrinos from interaction to detector." European Physical Journal C (2020)
   (c) "Probing the angular and polarization reconstruction of the ARIANNA detector at the South Pole." JINST (2020).

8. **Letters of Recommendation** (Advising and Mentoring)
   (a) Cassady Smith (2017)
   (b) Nicolas Haarlammert (2017)
   (c) John Paul Gómez-Reed (2018)
   (d) Nicolas Clarizio (2020)
   (e) Eliott Bergerson (2020)
   (f) Razmig Bartassian (2020) (2 letters)
   (g) Raymond Hartig (2020)
   (h) Taylor Watanabe (2020)
   (i) Raymond Hartig (2021)
   (j) Danny Diaz (2021)
   (k) Adam Wildanger (2021)
9. **Examples of Student-designed Final Projects**
   (a) Taylor Watanabe (MATH080), presentation
   (b) Teani White (PHYS135B), presentation
   (c) Emmie Fernandez (MATH080), presentation
   (d) Natasha Waldorf (INTD100), writing project
   (e) Scout Mucher (INTD290), infographic
   (f) Elmer van Butselaar (PHYS135A), paper
   (g) Andrew Householder, digital storytelling project
10. **Letters from Students and Colleagues**
   (a) Chistopher Clark, PhD (Office of Naval Research)
   (b) Taylor Watanabe, student from PHYS135A/B and MATH080
   (c) Raymond Hartig, student from PHYS150/PHYS180, PHYS306, INTD290, physics advisee
   (d) Nicolas Bakken-French, Whittier Scholars Program advisee
   (e) Email correspondence from Profs. Gragnani and Fedeli of Universtà de Genova regarding potential radar design collaboration
11. **ESAC Admissions Data Presentations**
   (a) Results presented November 15th, 2018
   (b) Results presented December 6th, 2018
12. **Grant Proposals and Evidence of ONR SFRP Grants**
   (a) Cottrell Scholars Grant Proposal
   (b) SFRP, Summer 2020
   (c) SFRP, Summer 2021
13. **Open Educational Resources (OER) Workshop Lectures**
   (a) Workshop January 28th, 2020
   (b) Workshop July 28th, 2020
   (c) Workshop March 2nd, 2021
14. **Course Materials Referenced in Teaching Section**
   (a) Error analysis in PHYS180, group lab activity
   (b) Paper about the contributions of Mexican astronomers in the late 18th Century, reading assignment for INTD290 (A History of Science in Latin America)

(c) Unit on nerve function, PHYS135B, lecture notes and activities

(d) Number systems of the Maya and Inca, asynchronous activities for INTD290 (A History of Science in Latin America)

(e) Spring Force Lab, lab activity for PHYS135A and PHYS150

(f) Example of an article bonus (see Teaching Section)

(g) Information on Artemis Program (see Service Section)

15. **Research Related Materials**

 (a) ***Whittier Scholars Program Thesis, Nicolas Bakken-French***

 (b) LA County Aerospace Cluster information sheet (See Research Section)

 (c) "The Changing Face of Aerospace in Southern California," report referenced in Research Section

 (d) Study regarding physics students by the American Institute of Physics (AIP) (see Equity and Inclusion Section)

 (e) IceCube Collaboration List of Institutions (See Research Section)

Bibliography

[1] E. Mazur, *Peer Instruction: A User's Manual.* Pearson Education, 2013.

[2] U. of Colorado, "Physics Education Technology." https://phet.colorado.edu/, 2018.

[3] "PhysPort: Supporting Physics Teaching with Research Based Resources." https://www.physport.org/methods/method.cfm?G=Peer_Instruction. Example of teaching material repository for PI module questions.

[4] "American Association of Physics Teachers Workshops for New Faculty." https://aapt.org/Conferences/newfaculty/nfw.cfm. See especially Fall 2018 pres by McDermott et al.