UNDERSTANDING LEARNERS' EXPERIENCES OF USING EPORTFOLIO IN A HIGH SCHOOL PHYSICS COURSE

by

Daniel P Carroll

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Daniel P Carroll

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The following individuals read and discussed the dissertation submitted by student Daniel P Carroll, and they evaluated the student's presentation and response to questions during the final oral examination. They found that the student passed the final oral examination.

Lida Uribe-Florez, Ph.D.	Chair, Supervisory Committee
Yu-Hui Ching, Ph.D.	Member, Supervisory Committee
Ross Perkins, Ph.D.	Member, Supervisory Committee

The final reading approval of the dissertation was granted by Lida Uribe-Florez, Ph.D., Chair of the Supervisory Committee. The dissertation was approved by the Graduate College.

DEDICATION

I would like to dedicate this dissertation to my family. It is dedicated to my wife Michele Ginnerty. This dedication is for being with me for all of these years and for continuing to support me in every wild idea I come up with. She is thoughtful, generous, creative, and intelligent. I could not have asked for a better partner or better friend. I look forward the next 33 years of marriage and am sure they will be as full of adventure as the first 33.

I also dedicate this work to my children Julia and Ryan. They are each a source of joy and inspiration. I hope they are as proud of me as I am of them.

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Finally, I would like to acknowledge my wife who has lifted me up at the worse moments of the past few years and convinced me to pick up and keep moving forward. I would also like to thank her for reading this dissertation and for helping me with my endless mistakes in grammar and punctuation" …"

ABSTRACT

There has been a move toward personalized learning and alternative types of authentic assessment in K-12 education. This shift toward personalized learning and authentic assessment has been partly driven by increases in the available technology that can support those types of changes. This dissertation is a basic qualitative study aimed at understanding the experience of learners in a first-year physics class working with an ePortfolio as the primary method of assessment for that class. The school in which this research took place fully implemented a 1:1 program and has been piloting personalized learning strategies for the past five years. The use of ePortfolios in some physics classes was part of those initiatives. The data used in this study were taken from written responses to reflective prompts in ePortfolios and a series of individual semi-structured interviews. Data were analyzed using a lens of self-efficacy and self-regulation. Results suggest that student experiences with ePortfolios include aspects of the development of academic self-efficacy and self-regulation along with self-reported reduction in academic stress.

TABLE OF CONTENTS

DEDICATION iv

ACKNOWLEDGMENTS v

ABSTRACT vi

LIST OF TABLES xi

LIST OF FIGURES xii

CHAPTER ONE: INTRODUCTION 1

Introduction 1

Background of the Study 5

Purpose of the Study and Research Questions 7

Significance of Study 8

Assumptions of the Study 9

Summary 11

Definition of Terms 12

CHAPTER TWO: REVIEW OF THE LITERATURE 14

Introduction 14

Theoretical Foundations 17

Self-Efficacy 18

Self-Regulation 21

Motivation 23

Academic Self-Efficacy and Implications for K-12 Education 23
Literature Review.....27
Inquiry in Science Education.....28
Personalized Learning.....30
Assessment and Authentic Assessment 34
Portfolio and ePortfolio.....35
ePortfolio.....38
ePortfolio Implications.....39
Summary.....42
CHAPTER THREE: METHODOLOGY 43
Introduction.....43
Statement of the Problem.....44
Research Questions.....45
Research Design.....46
Context.....48
ePortfolio.....50
Participants.....52
Sources of Data.....53
Data Collection and Management.....56
Data Analysis and Procedures 60
Themes:.....64
Ethical Considerations and Limitations.....65
Trustworthiness.....66

Summary 68
CHAPTER 4: FINDINGS 70
Participant Profiles 72
Data and Analysis 79
Coding 82
Themes 84
Addressing Research Questions 92
SQ1: Analysis 92
Summary of SQ1 103
SQ2: Analysis 104
Summary of SQ2 113
Analysis of Central Question: 115
Summary of CQ 123
Summary 125
CHAPTER 5: DISCUSSIONS OF RESULTS AND CONCLUSIONS 127
Summary of the Study 129
Discussion of Findings 130
Sub Question One (SQ1): 130
Sub question two (SQ2): 135
Central Question (CQ): 138
Implications 143
Limitations 146
Recommendations for Future Research 150

Conclusion 153

REFERENCES 157

APPENDIX A 173

APPENDIX B 175

APPENDIX C 184

APPENDIX D 189

APPENDIX E 193

APPENDIX F 199

LIST OF TABLES

Table 3.1 Reflective Prompts 54

Table 3.2 Semi-structured Interview Questions, Quarterly Conferences 56

Table 3.3 Themes and Sub-Themes 65

Table 4.1 Participant Data 73

Table 4.2 Overview of Student Statements about ePortfolio Experience. 78

Table 4.3 Reflective Prompts 80

Table 4.4 Semi-Structured Interview Questions 81

Table 4.5 Self-Efficacy Sub-Theme Coding 86

Table 4.6 Self-Regulation Sub-Theme Coding 89

Table 4.7 Academic Stress 91

Table 4.8 Sample of Experience Profiles from APPENDIX B 116

LIST OF FIGURES

Figure 2.1 The four levels of inquiry (Source: Banchi and Bell, 2008)..... 28

Figure 4.1 Self-Efficacy: Hierarchy of Coding Events 94

Figure 4.2 Self-Regulation Hierarchy of Coding Events 106

CHAPTER ONE: INTRODUCTION

Introduction

In K-12 Education there is currently a shift away from traditional models of instruction toward learner-centered and inquiry-based models (Miller, 2013; National Research Council, 2000). One new model has been described as personalized learning (Friend, Patrick, Schneider, & Vander Ark, 2017; Rickabaugh, 2016). This model is not necessarily new, as aspects of personalized learning are rooted in other pedagogical theories of the need for individualized attention to learners (Bartolomé, Castañeda, & Adell, 2018; Dockterman, 2018;). While not new, it has become established as a form of school change, research focus, and educational policy shift (Dockterman, 2018; Friend et al., 2017; Rickabaugh, 2016).

The increased prevalence of technology in schools has been a meaningful influence in that shift (Grant & Bayse, 2014). Access to technology and digital resources supports the personalization of learning and has created opportunities that did not exist before (Friend et al., 2017; USDOE, 2016). In order to facilitate the movement toward personalized learning, the way learning is assessed must also change (Marzano, 1992; Rickabaugh, 2016). Assessment is changing from traditional types of assessment such as multiple-choice tests to more authentic assessment such as open-ended questions and project-based assessment (Gulikers, Bastiaens, & Kirschner, 2004; Marzano, Pickering, & McTighe, 1993). Portfolio assessment has been defined as an effective type of authentic assessment that is supportive of personalized learning (Mabry, 1999; Rate,

2008). An ePortfolio is a digital development of a standard paper portfolio. A portfolio (or ePortfolio) used as assessment, is a collection of learner-curated artifacts and associated reflections to represent the process and progress of learning (Rate, 2008). An ePortfolio additionally makes that representation interactive and dynamic (Jensen & Treuer, 2014; Scully, O'Leary, & Brown, 2018).

This dissertation describes a basic qualitative study (Merriam, 2009; Merriam & Tisdell, 2015) to establish an understanding of the experience of learners creating an ePortfolio for the purposes of receiving a grade for a course. The experience of the learners was examined through each learner's written responses to reflective questions within the ePortfolio and through semi-structured interviews during regular quarterly teacher-student individual conferences. The written responses and conferences occurred as integrated parts of the ePortfolio evaluation process at the end of the third quarter of the academic year.

The ePortfolio experience was analyzed through the lens of academic self-efficacy and related self-regulative behaviors. Academic self-efficacy is related to academic success (Bandura, 1997) and self-regulative behaviors are necessary aspects of being a successful learner (Zimmerman, 1990). Both of these are closely related to the use of ePortfolios. Self-regulative behaviors like reflectivity, goal setting, planning and self-evaluation are inherent parts of ePortfolio assessment (Love, McKean, & Gathercoal, 2004; Scully et al., 2018). It is expected that students working with an ePortfolio are actively engaged in reflection and planning which could enhance their ability to self-regulate (Zimmerman, Bonner, & Kovach, 1996). There is a close link between the process of self-regulative behaviors and self-efficacy (Schunk & Ertmer, 2000). Since

self-regulation and self-efficacy are linked to the use of ePortfolios, I expected they should make a good base of analysis for the experience of learners.

The research presented in this dissertation was conducted at a large suburban public high school (2000+ students) in the Northeast Region of the United States. The participants were drawn from first-year physics students who were enrolled in a class that used an ePortfolio as the major assessment tool. In this classroom, the Canvas Learning Management System (LMS) was used in conjunction with the LabArchives Electronic Lab Notebook (ELN) to produce the ePortfolio. The ePortfolio was comprised of elements identified to be a purposeful assessment such as, summative assessments, problem solving; examples of work, responses to feedback, and reflective self-evaluation (Love et al., 2004; Rate, 2008; Scully et al., 2018). Students used the ELN as a repository for their lab work and collaboration on lab work with peers. Canvas was used for assignments, discussions, and traditional types of assessments and to house the ePortfolio. The ePortfolio structure was designed to allow for student decision, collaboration, and reflection about their learning. The submission requirements of the ePortfolio were established to support best practices established in the field of ePortfolio assessment (Love et al., 2004; Rate, 2008; Scully et al., 2018). A copy of the ePortfolio description that was included in the course syllabus is included in APPENDIX C.

The physics classes at this high school are part of a district-wide personalized learning initiative. In addition, the classes using ePortfolio were part of a school-based standards-based-assessment (SBA) pilot. A contingent of the teachers in the SBA pilot use the methods of student conferencing and ePortfolios as a way to assess student work and inform parents of student progress. The school district of the study has used the work

of Rickabaugh (2016) as the basis for the design of their initiative. In this context, personalized learning is a developing pedagogy in education, based on a constructivist model (Rickabaugh, 2016). Personalized learning can be enhanced with the implementation and availability of technology (Rickabaugh, 2016; USDOE, 2017). Alternative forms of grading, such as a standards-based approach, are seen as necessary components of personalized learning, because traditional approaches are too restrictive and fail to capture the full scope of the learning experience (Marzano, 2011; Rickabaugh, 2016). ePortfolio assessment can be used as an alternative form of assessing learner progress and achievement that is supportive of a personalized learning model. In that case both the learning and the assessment of learning are able to be personalized (Mabry, 1999; Marzano, 2011, Marzano et al., 1993).

Literature discusses the use of portfolios including the use of ePortfolios as authentic assessment tools in educational environments. This study seeks to go beyond grade-based achievement and focus on the experience of the learners using an ePortfolio as assessment. The experience was analyzed through the lens of academic self-efficacy and the related self-regulative behaviors. Academic self-efficacy is an important consideration in academic environments and a role of a successful academic environment should be to improve self-efficacy (Pajares, 2006). Likewise, self-regulation in academic environments can help lead to student success (Zimmerman, 1990). The importance of this point is discussed further in the section titled ‘Significance of the Study’. It is important to understand the experiences of learners in a learning environment with an alternative assessment to get insight into what the experience of ePortfolio assessment means to the learner. This understanding might help provide researchers with insight

necessary to drive additional directions of research about the use of ePortfolios in secondary schools as methods of assessment that support student-centered learning environments.

Background of the Study

The use of ePortfolio is a technological advancement of the portfolio practice. The use of portfolios for assessment began in the 1980's as an alternative method of assessment for language arts and was specifically designed to allow for a review of the progress of developing writers (Yancey, 1999; Yancey & Weiser, 1997). Certainly, the use of portfolios is common in the arts and in architecture where a portfolio can help communicate experience, expertise, ability, and accomplishment (Rate, 2008). For students in high school who are interested in pursuing the arts, a portfolio is necessary. The academic art portfolio consists of learner-curated artifacts and student reflections about the artifacts compiled in a portfolio and presented as a singular body of work (Gitomer, Grosh, & Price, 1992). While portfolio assessment has not had widespread adoption in K-12 education, it has become the norm for arts education. Assessment through the use of portfolios for other academic areas such as English has been shown to be supportive of student achievement and learner progress (Keefe & Jenkins, 2002; Marzano, 2011; Yancey, 1999).

The ePortfolio has been defined as a learner-centered and learner-defined product that would be a record of ongoing learning experiences (Jensen & Treuer, 2014). This type of learner-centered ePortfolio is generally not attached to one single course or experience and is instead a broad, inclusive body of work that shows progress on many levels in many areas (Jensen & Treuer, 2014; Love et al., 2004). Using ePortfolio as an

assessment tool for a single course supports this broader idea of a collective learner portfolio (Jensen & Treuer, 2014).

As with portfolio assessment, the use of ePortfolio has not been widely adopted by educational institutions or by individual instructors (Jensen & Treuer, 2014; Rossi, Magnoler, & Giannadrea, 2008). Even in institutions where the ePortfolio is a suggested requirement for graduation, students tend not to use them unless explicitly told to do so by instructors and their use tends to be more directed than spontaneous (Rossi et al., 2008).

One of the reasons I began using ePortfolios in 2011 was based on student reactions to traditional assessments, especially in advanced classes. In my experience, traditional assessments sometimes act as a de-motivator which is an aspect of assessment highlighted by the personalized learning community (Rickabaugh, 2016). One of my initial goals for using ePortfolio assessment was to get learners to focus on success and to understand their learning in the class as a continuum instead of a discrete event (Lewis, 2017). I believed that student perceptions of success in a course was based in academic self-efficacy (Bandura, 1997) and used that to begin thinking about the value-added feature of an ePortfolio used for the purposes of assessment. The focus of this study aligns with my belief that supporting academic self-efficacy was one of those value-added features.

My interest in academic self-regulation arose during a professional development I attended with a science colleague at another school. She was involved in professional project about increasing student skills in self-regulated learning (Zimmerman, 1990). The features of that effort had many of the same features of using an ePortfolio which is based

on reflection, goal setting, and self-motivation (Rate, 2008; Slepcevic-Zach, & Stock, 2018; Zimmerman, 1990). I included self-regulation in this study because it might be another value-added feature of ePortfolio assessment.

Purpose of the Study and Research Questions

The purpose of this basic qualitative study is to understand the experience of learners in a first-year physics class working with an ePortfolio as the primary method of assessment for that class. It has one central research question as discussed by Merriam (2009). The central question is the focus of this study and there are two sub questions that describe the lens through which the data will be analyzed (Cresswell, 2015). The central question is about the learner's experience and the sub-questions identify the lens as academic self-efficacy and academic self-regulatory behaviors. As in any study following a qualitative design, the sub questions were open to expansion or revision based on indications that occurred during the collection, coding, and analysis of the data (Bloomberg & Volpe, 2019; Cresswell, 2015).

- Central Question (CQ): How do learners in a physics class describe the experience of using an ePortfolio as the major assessment tool of that class?

The descriptions are drawn from written responses to reflective prompts and semi-structured interviews. The understanding of the experience will be addressed intentionally through the lens of academic self-efficacy and self-regulated behaviors. The sub-questions address those aspects.

Sub-Questions (SQ):

- SQ1: What aspects of academic self-efficacy do students include in their descriptions of their experiences of ePortfolio practice?

- SQ2: What self-regulative behaviors do students refer to in their description of their use of the ePortfolio assessment?

Significance of Study

There is evidence in the literature that portfolio assessment is an effective type of alternative assessment that supports learning and supports a shift toward a learner-centered pedagogy (Mabry,1999; Marzano, 2006, 2011; Marzano et al., 1993). The ePortfolio as a progressive development of portfolio assessment offers more opportunities to include the experiences and progress of the learner and is a more robust tool for assessing the level of learning of students (Buyarski, Oaks, Reynolds & Rhodes, 2017; Love et al., 2004; Rate, 2008; Scully et al., 2018). Even with the promise of ePortfolio assessment the practice has not gained a firm footing in educational institutions (Jensen & Truer, 2014; Scully et al., 2018; Watson & Dolittle, 2011).

While an important aim in educational research is to determine how changes in academic delivery, instructional methods, and assessment affect achievement, other factors may be equally important (Farrington, Roderick, Allensworth, Nagaoka, Keyes, Johnson, & Beechum, 2012). One consideration is that measures of achievement do not always fully reflect student learner and experience (Black & William, 2010; Marzano, 2011). There is value-added experience that learners gain from engaging in challenging coursework in school. The experience itself is important and can contribute to growth as a learner that could result in future success (Farrington et al, 2012). Some research on the use of ePortfolios has sought to understand aspects of the experience and to measure the achievement in other ways such as confidence, reflection, and depth of thinking (Baeten, Dochy, & Struyven, 2008; Cheng & Chau, 2009; Jimoylannis & Tsiotakis, 2016; Singer-

Freeman & Bastone, 2017). These alternate aspects of achievement are related to aspects of academic self-efficacy and self-regulation. Confidence in being successful at academic endeavors is one of the defining features of academic self-efficacy (Bandura, 1997) and reflection is a self-regulative behavior that leads to academic success (Zimmerman, 1990).

The importance of this study is to gain an understanding of how ePortfolios fit into the broader experience of learning. The description of that experience might shed light on the specific aspects of learning that are related to the use of ePortfolio as assessment. Understanding the experience and related aspects of learning can further the development of the use of ePortfolios as assessment to improve the support of learning. The purpose is to better understand the experience of the learner creating an ePortfolio for the purposes of receiving a grade for the course. This research is specifically using the lens of academic self-efficacy and academic self-regulation to frame the description.

Academic self-efficacy and academic self-regulation are aspects of social cognitive theory that illustrate how learners conceptualize their learning, their ability to learn, and their ability to effectively engage in the process of learning (Bandura, 1986a, 1997, 2012; Pajares, 1996; 2006; Schunk & Pajares, 2002). While academic self-efficacy and self-regulation were the guiding principle, they were not intended to be a limiting factor.

Assumptions of the Study

One of the primary assumptions of this study is that alternative forms of assessment are more supportive of learning and more meaningful than traditional assessment (Marzano, 1992). This assumption is supported by researchers and policy

makers as evidenced in the literature (USDOE, 2016). While there are multiple types of alternative assessments, ePortfolios represent a learner-centered and curated record of success and progress of learning (Buarski et al., 2017; Rate, 2008). Therefore, this study assumes that it is valid to use an ePortfolio as the primary assessment tool for a course.

A second assumption of the study is that it is important to understand how academic self-efficacy and self-regulation are related to the learning process. This assumption is supported by aspects of research presented in the literature review. School is a place that can and should pay attention to the development of academic self-efficacy of learners (Bandura, 2006, 2012; Pajares, 1996, 2006; Schunk & Pajares, 2002; Zimmerman & Cleary, 2006). In this study, self-efficacy and self-regulation were the lens through which the experience was analyzed.

A set of assumptions about the study surround the limitations mentioned in chapter 3 of this document, specifically that the teacher of the course was also the researcher. It is assumed that even with this fact, that students were honest in their reflections about the ePortfolios and their experiences creating the ePortfolios for the purpose of determining a class grade. It is assumed that the teacher/researcher was able to create an environment where students felt comfortable to speak honestly and frankly about the ePortfolio process. This assumption was assisted by having the conferences recorded as part of the regular procedure of the class. The teacher/researcher worked to foster a feeling of trust on the part of the student during the first two evaluations of the ePortfolio (first two quarters). The teacher/researcher has twenty-eight years of experience in the classroom which facilitated a student-centered and trustworthy environment.

The last key assumption of the study is that the design of an ePortfolio contains elements that are supportive of the development of academic self-efficacy. Self-assessment, self and peer modeling, vicarious experience, reflection, self-regulation, and goal setting are all aspects of ePortfolio practice and of the development of self-efficacy (Chang, Liang, Chou, & Liao, 2018; Rate, 2008; Schunk & Pajares, 2002) This final assumption leads to the belief that student experiences will include cognitive recognition of the use or development of strategies that represent self-regulated behaviors and academic self-efficacy.

Summary

This chapter introduces the study by defining its parameters and place in the ongoing development of personalized learning. The important feature of the study is to gain an understanding for the student experience using an ePortfolio that is defined as a specific type of authentic and learner-centered assessment.

This chapter also provides an overview of relevant research and general theoretical foundations of the researcher. The research referenced and discussed these elements more fully in Chapter 2. It includes the relevant pedagogical developments of personalized learning and the supporting assessments as well as the underlying analysis concepts of academic self-efficacy and the related self-regulative behaviors.

This research was conducted by the teacher of the courses. As a participant-observer, the researcher engaged with the students on a daily basis and had an opportunity to support the students while they were learning physics and working on their ePortfolios. The issue of the researcher as participant-observer is highlighted in the assumptions of the study discussed in this chapter and is discussed more fully in the

limitations in Chapter 3. The discussion of those limitations addresses methods about how the teacher-student relationship was kept separate from the researcher-student relationship.

The data is described and analyzed in Chapter 4. Each research question is directly addressed and visual representations of the analysis are provided to give a general picture of how the student experience was interpreted. Those descriptions are followed by Chapter 5 where the meaning of the analysis is applied to the questions and the understanding of the student experience as it pertains to this research is provided. This is followed by a suggestions for future research, implications for K-12 education and a conclusion of the research.

Definition of Terms

There are some terms that will be used throughout the study and it may be helpful for those terms to be identified to facilitate the reading of the remainder of the chapters.

Standards-Based-Grading or Assessment (SBG, SBA): This is framed by the work of Marzano (1992, 2006, 2011). SBA refers to the use of ranking standards to assess student learning. Even when traditional types of assessments are used (quizzes, tests) they are used to create a rank of achievement on a standard.

Personalized Learning: This is a shift in pedagogy toward a more student-centered approach in education. It is defined by Rickabaugh (2016) and Friend, Patrick, Schneider, and Vander Ark (2017), as beyond differentiation and individualization to give the student a voice in how learning progresses and is assessed.

Electronic Lab Notebook (ELN): An electronic lab notebook is a web-based repository and digital tool for recording and analyzing data and producing electronic lab

reports. The ELN used in this research is LabArchives which is one of the leading laboratory management software packages managed by LabArchives, LLC, San Marcos, CA.

Learning Management System (LMS): A learning management system is used in an educational institution as a collective assignment and grading system to provide a container for learning activities and assessment. The LMS used in this research is Canvas, which is a product of Instructure, Salt Lake City, UT.

ePortfolio: An ePortfolio is defined in this study as a learner-curated collection of artifacts to be used for the purpose of assessing the student's progress in physics (Rate, 2008). The artifacts included: inquiry-based lab work, cooperative and independent problem-solving, traditional types of assessments. In addition, the artifacts were described and defined by learners using reflective narratives about the course standards addressed by each article (Love et al., 2004, Rate, 2008; Scully et al., 2018). The description provided in the syllabus for the class can be found in APPENDIX C and examples of student portfolios are in APPENDIX D.

Academic Self-Efficacy: Academic self-efficacy is defined by Bandura (1997) as the belief of an individual about their ability to be successful in a particular academic setting presented with particular academic tasks.

Academic Self-Regulation: Academic self-regulation refers to the set of behaviors and skills that contribute to academic success (Zimmerman, 1990). These behaviors include planning, goal setting, reflection, self-monitoring (Zimmerman, 1990).

CHAPTER TWO: REVIEW OF THE LITERATURE

Introduction

Schools are making a shift away from traditional models of instruction and adopting learner-centered models such as inquiry-based instruction (Miller, 2013; National Research Council, 2000). With these methods, the focus is on understanding and demonstrated mastery of established standards (Marzano, 1998; Miller, 2013). One concern is that traditional types of assessment and grading do not adequately measure understanding (Johnson, Mims-Cox, & Doyle-Nichols, 2009; Marzano, 1992, 1998; Phye, 1996); therefore new strategies have been used in classrooms. One strategy that is supportive of a learner-centered classroom is ePortfolio assessment (Johnson et al., 2009; Marzano 1998). While ePortfolios have been understood as an effective method of assessment they are still not widely used. Research is necessary to understand all aspects of ePortfolio as assessment which includes understanding the experience of the learner (Rhodes, Chen, Watson, & Garrison, 2014: Watson, Kuh, Rhodes, Light, & Chen, 2016). This study was designed to establish an understanding of the experience of the learners creating an ePortfolio for the purposes of receiving a grade for a course. This question is derived from the professional experience of a practitioner who has been using ePortfolio in this manner for a high school physics class for the past seven years. The genesis of the development of this study comes from the researcher's professional experience through more than twenty years of teaching high school physics.

There is a need to focus on the process and experiences students have in the classroom. Often changes in practice are implemented in order to obtain high achievement in learners and analysis of practice centers around measuring achievement. The focus on achievement alone addresses only one dimension of learning (Marzano et al., 1993). The purpose of this research goes beyond achievement and entertains the idea that there are other dimensions to learning that create value-added features of a high school class not directly measured through achievement. Consciously experiencing success in an academic situation can lead to a strengthened academic self-efficacy and learners with higher self-efficacy generally experience success (Bandura, 1986, Pajares, 1996). Processes that support the development of the self-regulated behaviors necessary for academic success have been shown to also have an impact on academic self-efficacy (Zimmerman, 2000; Zimmerman & Bandura, 1994). The ways of knowing about achieving success are varied and the cognitive processes through which individuals perceive their progress are complex (Bandura, 1986a). The lens through which the data in this study will be analyzed is academic self-efficacy and the related aspects of self-regulation.

Self-efficacy is an important cognitive feature of human development and academic self-efficacy is an important cognitive feature of learners (Bandura, 1986a; Pajares, 1996). The experience of a learner in a course is influential in the development of academic self-efficacy and one of the roles of education should be supporting that development (Pajares, 1996). In addition, developing the self-regulated behaviors necessary for academic success helps create a positive learning experience (Zimmerman, 2000).

It has been my experience in observing years of student engagement that traditional forms of assessment (quizzes and tests) can be helpful in a very general sense of student understanding, but that they often lead to false conclusions of success and failure, both by students and teachers. This experience is supported by the work of Black and William (1998a,1998b), Marzano (1992, 2011), and Marzano, Pickering and McTighe (1993) that addresses the need to change assessment techniques to support a learner-centered classroom. Sometimes students create a flawed self-narrative about their level of success as a result of traditional assessment techniques. This is especially apparent in advanced classes like physics where a generally acceptable or even advanced understanding of the content and processes could be masked by simple errors in calculation (Marzano, 2006, 2011). In my experience, advanced learners often erroneously conclude that they have not been successful in learning physics if they have minor setbacks on traditional assessments.

Over the past few years, I have been working with other teachers in the school on alternative forms of grading (standards-based grading) and assessment (portfolio-based assessment). It is my general observation that the changes in grading and assessment may not really change the academic success of the learners but that it does seem to change how students feel about their attempts at success. This made me wonder if the learning benefits of working on a portfolio might be understood using the lens of academic self-efficacy theory which includes self-efficacy for the self-regulated behaviors needed for success. The use of an ePortfolio is not really about changing performance on an academic measure, it is really about changing the process and meaning of the learning process (Stefani, Mason, & Pegler, 2007). Thinking about changing the process and

meaning of learning an assessment is how I came to the goal of attempting to understand how students perceive the experience of using an ePortfolio. I decided on a qualitative method because my question goes beyond whether using an ePortfolio results in changes in academic self-efficacy. I am interested in understanding if the way that students talk about the experience of using ePortfolio would indicate that some components of academic self-efficacy might be involved in that experience and if they specifically discuss self-regulation.

The introduction will be followed by a discussion of the theoretical foundations of this research and the literature review. The theoretical foundations section will include three parts. The first is the about self-beliefs which encompasses the lens of self-efficacy and how it is related to other cognitive aspects. The second is the theoretical foundation of the use of ePortfolios as assessment. This will include a discussion of understanding as the goal of learning, value-added aspects of high school courses, and the meaning of academic achievement. The third will be a brief overview discussion of how ePortfolios can function as an effective alternative form of assessment. The literature review will follow the theoretical foundations and will be organized in three sections that will address changes in practice, changes in assessment to match changes in practice, and the role of these changes in academic self-efficacy and self-regulation.

Theoretical Foundations

The constructs of social cognitive theory are interrelated. Self-beliefs, motivation, expectancy beliefs have connections in how they describe the decisions people make and how they perceive the outcomes of those decisions (Bandura, 1986a, 1997, 2012). Self-efficacy is related to the expectancy belief of individuals or how a person perceives a

situation and how they perceive their ability to perform certain tasks and achieve a level of success (Pajares, 1996). Outcome expectancy is related to self-efficacy in that it indicates what a person believes will be the outcome of their behavior (Zimmerman, 2000).

Social cognitive theory is a way of thinking about how people act and react within their environment. This action-reaction relationship has been described as a triadic reciprocal model between personal determinants, behavioral determinants, and environmental determinants to represent that relationship (Bandura, 2012). Self-efficacy is part of that theory in that it describes a person's belief about their own self-agency and ability to interact with the environment (Bandura, 2012).

Self-Efficacy

Self-efficacy is one of several self-beliefs or self-referential constructs that are a part of social cognitive theory. The basic tenet of self-efficacy is that it is a belief system that an individual maintains about their personal capability for performance (Bandura, 1986, 1997, 2012; Pajares, 1996; Zimmerman, 2000). The concept of self-efficacy is important for education, because it has an influence on how learners interact with the learning environment. It influences the types of goals learners set, the courses and course directions they choose, the amount of effort they exert in pursuing the goals, and how well they can persevere when they encounter roadblocks (Pajares, 1996; Zimmerman, Bandura, & Martinez-Pons, 1992).

Bandura (1997, 2012) distinguished self-efficacy from other self-beliefs such as self-concept and self-esteem. One point is that it is distinct from other self-beliefs in its specificity. It more specifically pertains to an individual's perceived capabilities and

ability to apply those capabilities to achieve a certain result or level of success (Pajares, 1996), and is an expectancy of performance that is task and concept specific (Bandura, 2012; Zimmerman, 2000).

Self-esteem is a very general self-belief that is a value judgment that one has about their own capabilities and how they feel about those capabilities (Bandura, 1997; Zimmerman & Cleary, 2006). Self-efficacy is different than self-esteem in that it is not a judgment necessarily about the value of the capabilities but of the belief in the capabilities themselves (Bandura, 1993, 1997, 2012). An individual's belief about having the capability of being successful is not always related to self-esteem and self-worth (Bong & Skaalvik, 2003).

It is important to make the distinction that self-efficacy is different than self-concept because self-concept is a broader self- interpretation about abilities and attributes while self-efficacy is a more complex set of cognitive beliefs about capability in a particular context and is more closely linked to behaviors in that context (Bandura, 1997, 2012). However, some researchers argue that the distinction may not always be clear (Bong & Skaalvik, 2003; Marsh, Pekrun, Parker, Murayama, Guo, Dicke, & Arens, 2018). Marsh et al. (2018) discuss the possibility that the distinction between the two is made less clear by attempts to make domain specific self-concept scales and generalized self-efficacy scales which blurs the lines between the two.

The distinction between self-efficacy and self-concept is sometimes mistakenly made that self-efficacy is more specific and is related to a particular content area, while self-concept might also be specified to a particular content area. The distinction is really that self-efficacy is specifically about a person's beliefs about their capabilities to

perform certain tasks in the content area and achieve a specified result. It is content and task specific (Bong & Skaalvik, 2003). Another distinctive difference is the internal cognitive treatment that results in self-concept and self-efficacy. The self-concept involves an affective reaction to beliefs about capability and self-efficacy and is more focused on the cognitive evaluation of capabilities and beliefs about the ability to apply those capabilities (Zimmerman, 2000). Pajares (1996) also offers a distinction that the base of self-concept beliefs is a social comparison. An individual considers how their capability compares to a global or specific group and ranks themselves either above or below that perception. Self-efficacy beliefs center on the perception of whether one has the ability to successfully complete a specified task. (Pajares, 1996).

It is important for academic research to include a focus on understanding the relationships between self-efficacy and features of self-regulatory strategies (Pajares, 1996). Self-efficacy beliefs would be the impetus for engaging in self-regulated behaviors that would lead to success (Bandura 1997, 2012; Zimmerman & Cleary, 2006; Zimmerman, Bonner, & Kovach, 1996). Pajares (1996) stated that efficacy beliefs indicate how much effort people will expend and to what extent they will persist when tasks are difficult. He also linked efficacy to patterns of thought and behavior. People with high self-efficacy are more emotionally available to engage with difficult problems and are able to have a much broader scope than those with lower self-efficacy (Bandura, 1997, 2012; Pajares, 1996).

It is in the discussion of expectancy beliefs that Kirsch (1985) makes an argument with Bandura on the relationship between self-efficacy and performance. As an opposition to Bandura's studies of people with phobias about snakes, a study by Kirsch

(1982) showed subjects could be persuaded to change their judgments of outcome expectancy based on a hypothetical reward. That change was reflected by thoughts of how difficult the task was and whether they possess the skill to achieve it

Bandura (1986b) also discusses the idea of this thought process and attributes the phobic response to an imagined outcome that prevents the engagement. A phobic person imagines an outcome based on their perceived lack of efficacy (Pajares, 1986). While general academic settings aren't thought of as situations typical of phobic responses, a similar thought process could prevail. A self-belief of the lack of capabilities could imagine a failure or poor performance which could result in response behaviors that interfere with academically appropriate behaviors (Bandura, 1993; Pajares, 1986, 2006; Schunk & Pajares, 2002).

Self-Regulation

Having the capability to perform a task is not enough to be able to perform it. One must also possess the self-regulatory behaviors to be able to apply those capabilities. Judgments about self-regulatory skill are part of self-efficacy judgments (Bandura, 1997). Self-regulation is the set of behaviors that would reasonably be expected to lead to the successful fulfillment of self-efficacy beliefs. Self-regulative behaviors are the skills that enable a person to be able to organize, prioritize, and process the demand and actions necessary for success (Zimmerman, 1990). There are three features of self-regulated learning discussed by Zimmerman (1990). They are use of strategies, responsiveness to feedback, and motivation to succeed. He points out that these features are necessary for students to be successful. Bandura (1997) reasons that building self-regulative behaviors should be an important consider of educational systems because it has a significant role in

forming self-efficacy beliefs. The interaction with self-efficacy is part of the process of self-regulation.

Baumeister and Heatherton (1996) identify self-regulation as a feedback loop in academic environments: setting standards, monitoring (self and standards), operating to achieve standards. Zimmerman (1990) defines the set of self-regulated processes as a cycle that includes: self-evaluation and monitoring, goal setting and planning, strategy implementation, and outcome monitoring. In this self-regulated cycle, there is a cognitive self-awareness of how their effort results in learning outcomes and a self-awareness of their ability to change their work or use of strategies to improve outcomes. Zimmerman (1990) posits that a learner will improve outcome by analyzing how their self-efficacy beliefs compare to the actual outcome they achieved and then determining how to adjust strategies to achieve improved results. As the link between self-efficacy and actual performance improves a positive feedback loop is created. This loop is defined by an improvement in performance resulting from effective self-regulation. The improved performance and recognition that the improvement resulted from a successful capability to change strategies to improve performance will result in an increase in self-efficacy (Zimmerman, 1990). That belief system will enhance both self-regulation and self-efficacy which will result in improved future performance.

Essentially, self-regulatory skills are the task specific behaviors that are necessary to complete tasks successfully. Having high self-efficacy for a domain-specific task would not only require a belief that one has the intellectual ability to accomplish the task, but that one also has the self-regulatory skills and the ability to apply those skills successfully (Zimmerman et al., 1996; Zimmerman et al., 1992; Greene, 2018).

Motivation

Academic motivation is important for academic success (Greene, 2018; Pajares, 2003). In social cognitive theory, motivation has been linked to self-efficacy in that motivation is a cognitive process that is influenced by perceived capability and expectancy beliefs (Bandura, 1997). There are two general types of motivation extrinsic and intrinsic. Often in school we use the extrinsic motivation of rewards and punishment to motivate students to produce results. It is the intrinsic motivation that creates a self-motivated, self-regulated learner (Greene, 2018). Both Bandura (1997) and Greene (2018) discuss the importance of future goals and point out that future goals cannot produce future motivation. They point out that future goals are necessary for learners to understand the tasks and paths that must be undertaken to reach the goals. In that process, the future goal is turned into current tasks and can produce self-motivation for working toward success. It is self-efficacy that allows learners to believe goals are attainable (Bandura, 1997; Greene, 2018; Zimmerman et al., 1992).

Academic Self-Efficacy and Implications for K-12 Education

Specifically, academic self-efficacy refers to the beliefs of individuals in an academic context and would indicate the beliefs that learners have for their ability to successfully apply capabilities to lead to academic success, (Bandura, 1977,1997). The general principal of self-efficacy is applied to an individual's self-beliefs about a particular academic area.

Academic self-efficacy has significant implications for K12 education. The primary impact that it would evidently have is in achievement. Learners who believe they have the capabilities to achieve and who believe they possess the ability to successfully

apply those capabilities will be more successful that learners who do not (Bandura, 1997). Academic self-efficacy has far more implications for academic success than raised achievement. It also has an effect on what paths learners choose and how much of an academic challenge they will pursue (Schunk, 1996). Pajares (2006) states that self-efficacy is a critical determinant of life choices and that in academic environments learners will choose the easy path and avoid things that are out of their comfort zone. He further points out that the intent of education is to increase an individual's knowledge and skill and it is self-efficacy beliefs that help determine what individuals will do with that knowledge and skill.

Self-efficacy spans a number of areas of cognitive theory. Academic self-efficacy is a particular application of the theory of self-efficacy (Bandura, 1977, 1986a; Pajares, 1996, 2006; Schunk & Pajares, 2002). Bandura (1986a, 1997) highlights social constructs where self-efficacy theory may have positive application. He discusses self-efficacy as a cognitive function that has influence in academic, personal, and professional life. He includes applications for cognitive processes in health and clinical treatments and for athletic and organizational performance. The academic applications are included in his evaluation of cognitive functioning. The importance of academic self-efficacy is that it has direct links to performance. Bandura (1997) states that efficacy beliefs influence motivation, interest, and attitude toward subjects. He gives the example that students with high self-efficacy in math tend to have positive attitudes and are more successful than students of the same ability who have low self-efficacy. Since self-efficacy is context specific (Bandura, 1986a, 1997) academic self-efficacy is a distinct example of efficacy beliefs (Pajares, 1996). Within academic environments efficacy beliefs are context

specific for various subject areas and particular courses (Pajares, 1996). The applications within the academic realm of self-efficacy involve the influences of student success and even the willingness to enroll in and pursue areas of study (Bandura, 1997, Pajares, 1996)

Bandura (2006) identifies mechanisms by which efficacy beliefs influence the cognitive development of the learners in an academic environment. The first mechanism is the efficacy beliefs of the learner about whether they have the capabilities and the self-regulation to succeed. The second is the efficacy beliefs of the teacher in whether they believe they have the skills and ability to motivate students and provide effective learning environments (Bandura, 2006). The third is the collective efficacy of the organization about whether academic progress will be made. While the first might apparently be the most important for the achievement of the individual, environmental concerns may have either positive or negative influences on individual self-efficacy (Bandura, 1997).

In academic settings, goal setting is a self-regulated behavior that has multiple effects on performance (Bandura, 1997, Greene, 2018, Zimmerman and Cleary, 2006). Zimmerman and Cleary (2006) discuss the role of goal setting as a feedback loop for self-efficacy. Strong process-specific goal setting behaviors lead to increased efficacy beliefs whereas generalized goals do not. The specific reflection about the process rather than the general desired outcome of the process increases the learner beliefs about their capabilities to be successful. Greene (2018) provides an additional consideration of goals as a partner with self-efficacy beliefs that both process goals and future goals are important because future goals provide meaning or impetus to set process goals and continue working at difficult tasks. Students who are able to find meaning in the development of efficacy beliefs work harder at doing so.

Consistently, academic self-efficacy has been found to be positively related to achievement (Bandura, 1997, 2012; Pajares, 1996; Schunk, 1996; Usher & Pajares, 2008b). Pajares (1996) indicates that the effect of self-efficacy on performance is stronger in mathematics than it is for other academic areas and that even more generalized measures of mathematical self-efficacy can be predictive. Sitzmann and Yeo (2013) performed a meta-analysis to understand the inter-relationship between self-efficacy and performance and other moderators when impacted by other moderators such as goal-setting and past performance. They propose that there is a larger effect between past performance and self-efficacy than between self-efficacy and future performance. As part of their analysis, they performed a linear trajectory to make predictions about future performance based on past performance and argue that removing that linear trajectory from self-efficacy gains reduces the apparent effect of self-efficacy. Bandura (2012) argues against this type of conclusion. He points out that self-efficacy is a feedback loop. Past performance is a part of self-efficacy and experiencing success improves self-efficacy. The effect of past performance on self-efficacy is strong, strong past performance and strong self-efficacy lead to strong performance (Bandura, 2012). There are also indications that along with good performance leading to stronger self-efficacy, when self-efficacy is strong it is not as significantly affected by incidental failure (Bandura, 1986).

Academic achievement is perceived to be aligned with academic success and is therefore an important consideration for educational research. There are other aspects of K12 education that are also important. The academic path that learners choose through school is an important consideration for future opportunities. Self-efficacy beliefs of

learners have an influence on which choices they will make about academic challenges and pathways (Pajares, 2006). Students who have diminished self-efficacy will likely not choose to engage in activities where they perceive they will not succeed.

Literature Review

The literature review consists of three parts. The three parts will tie the literature together connecting the use of ePortfolio as assessment to the pedagogy of teaching science. Part one will provide an overview of inquiry-based instruction as the primary pedagogical approach to teaching science. It will also include a discussion about how personalized learning as a new pedagogical approach supports inquiry. The main focus of this section is to describe how assessment can and should change to support these pedagogies, and how standards-based grading is an important component.

Part two will be specifically about the development of ePortfolio as an assessment process. This will include a historical overview of the use portfolios in education, types of portfolios and ePortfolio practice. It will also provide support for the use of ePortfolio as an assessment for personalized learning and will show how an ePortfolio supports inquiry-based instruction in science. The research also reveals barriers that remain to implementation of ePortfolio assessment.

Part three is a technical and technological focus. This will be an overview of ways that technology has been implemented that are supportive of ePortfolio and how accessibility can change the level of collaboration. It will also include a discussion of research that addresses aspects of ePortfolio assessment that might be supportive of academic self-efficacy and self-regulated learning.

Inquiry in Science Education

Scientific inquiry is supported as an important part of science instruction by the National Science Teachers Association, the American Association for the Advancement of Science (AAAS), and the National Science Foundation (NSF). Inquiry as a focus in science education gained attention in the late 1950's with the launch of Sputnik and has gradually gained focus most notably with the generation of National Education Policy documents in the 1990's and early 2000's (Barrow, 2006).

Inquiry in the science classroom as published by Banchi and Bell (2008) is a hierarchical model that has been adopted by the National Science Teachers Association as the accepted pedagogical basis of effective science education. Figure 2.1 below shows the four levels of inquiry.

The four levels of inquiry and the information given to the student in each

Inquiry Level	Description	Question	Procedure	Solution
1-Confirmation	Students confirm a principle through an activity when the results are known in advance	X	X	X
2-Structured	Students investigate a teacher-presented question through a prescribed procedure	X	X	
3-Guided	Students investigate a teacher-presented question using student/designed selected procedures	X		
4-Open	Students investigate student formulated questions through student designed/selected procedures			

Figure 2.1 The four levels of inquiry (Source: Banchi and Bell, 2008)

This chart describes each level of inquiry and gives an indication as to the degree of independence exercised by the students at each level. This table is used by NSTA (National Science Teachers Association) to reinforce the use of inquiry. The hierarchical model uses "Question, Procedure, and Solution" as the major descriptors of an inquiry

event. The question refers to the research question that is the basis for the inquiry, the procedure is describing what data will be collected and prescribes the method for collecting it, and solution means there is an expected result that learners will get. While it is considered that science teachers should move students toward open inquiry, there is a place for all levels of inquiry in a rich science learning experience. As an educator moves from level 1 to level 4 the learning becomes much more learner centered.

Inquiry as a process is a very important aspect of science education (Colburn, 2000). There have been different variations of the levels of inquiry model that follow this particular hierarchical structure. The structure is based on the level of student control over the inquiry process which Bevins and Price (2016) refer to as the Question-Procedure-Result-Interpretation (QPRI) model of scientific inquiry. Bevins and Price make an additional argument that the QPRI model may be short-sighted in an educational environment, because it may not always be possible to support open-inquiry and this process does not represent alternative acceptable approaches to scientific inquiry. It may not always be necessary for students to be engaging with a standard model of inquiry or to have the inquiry be entirely student driven in order to have a rich learning experience in science (Bevins & Price, 2016; Minner, Levy, & Century, 2010).

The argument for increasing inquiry-based instruction builds from the basic premise that science education is best accomplished through some form of inquiry process. Minner et al. (2010) performed a meta-analysis of research on inquiry-based science programs and found that there were positive effects of the increase of student-centered inquiry on all aspects of learning. An important point made in that research was that time-based recall was strongest for concepts learned through inquiry.

Moving toward open-ended inquiry would necessarily require a student to be able to design their own inquiry experiences which would include developing the questions to be asked. This is the basis of personalized learning (Rickabaugh, 2016). Through personalizing inquiry-based instruction and encouraging collaboration and communication it is possible to help students think of more interesting questions and to engage themselves further in thinking about science. Having the opportunity to think creatively in science is an important aspect of inquiry and an important aspect of personalized learning (Barrow, 2010, Rickabaugh, 2016)

While the major push for inquiry learning in science was occurring in the 1990's the prevalence of technology in the classroom was limited for most schools. The rapid introduction of computers, mobile devices, and internet access in schools has opened an entire new opportunity for engaging in inquiry.

Personalized Learning

Inquiry-based learning is derived from a constructivist pedagogy (Bevins & Price, 2016; Minner et al., 2010). Inquiry-based learning is not limited to science education and is part of a larger push to make education more learner-centered and meaningful. Other domains such as social studies, humanities, arts, and mathematics benefit from the same real-world and engaging approach (Blessinger & Carfoura, 2014; Rasmussen & Kwon, 2007). The push for inquiry leads to a change in the approach to delivering instruction to learner where the learner is given increasing amounts of control of what and how they learn. This push toward a more significant shift to constructivism is known as personalized learning (Keefe & Jenkins, 2002; Rickabaugh, 2016). The U.S. Department of Education (USDOE) defined personalized learning in the National Education

Technology Plan (2010). In this plan, definitions for three types of student-centered pedagogies were described as individualization, differentiation, and personalization. Those definitions are summarized as follows:

Individualization refers to instruction that is paced to the learning needs of different learners. In this pedagogy, learning goals are the same for all students, but students can progress through the material at different speeds according to their learning needs. For example, students might take longer to progress through a given topic, skip topics that cover information they already know or repeat topics they need more help on.

Differentiation refers to instruction that is tailored to the learning preferences of different learners. As for the previous pedagogy, learning goals are the same for all students, but the method or approach of instruction varies according to the preferences of each student or what research has found works best for students like them.

Personalization refers to instruction that is paced to learning needs, tailored to learning preferences, and tailored to the specific interests of different learners. In an environment that is fully personalized, the learning objectives and content as well as the method and pace may all vary (so personalization encompasses differentiation and individualization). (USDOE, 2010).

The definition for personalized learning indicates that it would be a combination of individualization and differentiation (Rickabaugh, 2016; USDOE, 2010). One of the leaders of the Personalized Learning movement is James Rickabaugh, the senior advisor for and former director of the Institute for Personalized Learning (IPL) (Rickabaugh, 2016). Rickabaugh and the Institute for Personalized Learning are working to define personalized learning and to assist educational institutions in implementing personalized

learning models. Rickabaugh (2016) identifies a shortfall in the U.S. DOE definition that it leaves out the role of the learner and the shift of responsibilities of teachers and learners. In the update of the Education Technology Plan, the definition is expanded somewhat to include student input.

> Personalized learning refers to instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) may all vary based on learner needs. In addition, learning activities are meaningful and relevant to learners, driven by their interests, and often self-initiated. (USDOE, 2017).

In the update, the definition has moved beyond the passive notion that the pace and content will be varied. Simply changing the approach does not make learning personalized. Those changes have to be purposeful and meaningful (Keefe & Jenkins, 2002; Pane, Steiner, Baird, & Hamilton, 2017; Rickabaugh, 2016)

An important feature here is that the personalized learning definition and discussion is included and defined in the National Educational Technology Plan (USDOE, 2017). The implication is that technology is an important part of personalized learning. Many of the supporters and researchers of the concept of personalized learning make this point (Rickabaugh, 2016). The advancement and proliferation of technology makes learning more accessible (Pane et al., 2015). Every aspect of the shift to personalized learning is facilitated through the use of technology and technology is an important factor in the success of those shifts (Pane et al., 2017; Twyman, 2014; Wolf, 2010). Technology can play a part in all aspect of personalization, differentiation, and

individualization, but in personalized learning it is not the central focus. The way in which the learner chooses to leverage the technology is more important and often the use in academic learning reflects other personal uses (Bray and McClaskey, 2013; Twyman, 2014).

Personalized learning may not have a distinct definition, but it does have common themes across the literature. The transition to personalized learning includes types of learning that become increasingly learner focused which include individualized instruction, education plans without traditional grades, and the move away from age-centered grade levels. (Keefe & Jenkins, 2002). An abbreviated list of elements identified as Keefe & Jenkins (2002) as elements of personalized learning are:

1. Teachers have a dual role of coach and adviser
2. The diagnosis of relevant student learning characteristics.
3. A culture of collegiality in the school between learners and instructors
4. An interactive learning environment (small groups, thoughtful conversation, active learning, authentic achievement)
5. Flexible scheduling and pacing
6. Authentic assessment.

These elements are included in some form throughout the literature. Pane, Steiner, Baird, & Hamilton (2015) identify similar qualities in schools and organized them as core attributes, “Learner Profiles, Personal Learning Paths, Competency-Based Progression, Flexible Learning Environments, Emphasis on College and Career Readiness”. The common themes are evident: flexibility, learner-focused, authentic (Keefe & Jenkins, 2002; Pane et al., 2017, Rickabaugh, 2016).

The pedagogical approach of inquiry in science is supportive of and supported by the move toward personalized learning (Rickabaugh, 2016; Song, Wong, & Looi, 2012). By definition, open inquiry would be an example of personalized learning because in that scenario the learner is designing the entire inquiry event. In a personalized learning environment, the learner is central to the design of the learning path.

Assessment and Authentic Assessment

Assessment is an important aspect of instruction and the learning process. It is a tool that can be used to both document and enhance learning (McMillan & McMillan, 2008). Traditional types and methods of assessment may not meet the higher objectives of assessment as a component of the learning process (Marzano, 1992; McMillan & McMillan, 2008). Assessing the progress of learners helps build an understanding of what the learner has mastered and what work is still to be done. From assessments, teachers can make decisions about extension or remediation and about ways to meet the needs of the individual learners in the classroom. There are a variety of assessments that can be used for the purpose of gaining this information. Traditional types of assessment such as quizzes and tests tend to be summative in nature and mostly serve to quantify the learning of students.

Marzano (1992) discusses the "five dimensions of learning" and how assessment acts as a functional part of those dimensions. The dimensions of learning are defined as: positive attitudes and perceptions about learning, acquiring and integrating knowledge, extending and refining knowledge, using knowledge meaningfully, and productive habits of mind. Marzano argues that traditional assessments do not address the dimensions of learning and that new ways of assessing students must be developed to specifically

strengthen the dimensions. He also identifies that current instructional goals are designed to foster higher level thinking and extended thinking, collaborative learning, and developing self-directed learners. None of these goals are effectively met with traditional types of assessments (Gulikers et al., 2007; Marzano, 1992).

Nicol and Macfarlane-Dick (2006) summarize research about formative assessment and feedback as a significant support of learning. Formative assessment is defined as assessment that is part of the learning process and that generates feedback about performance (Marzano, 2011; Sadler, 1998). The use of formative assessment is designed to provide a vehicle to give feedback to learners so that the learners can make adjustments and use that feedback in the process of learning. This process is an essential part of self-regulated learning and it allows learners to maintain control of the learning process (Nicol & Macfarlane-Dick, 2006). Formative assessment and feedback are two of the strongest correlates of achievement in Hattie's 2008 meta-analysis of educational research. Hattie also states that it is not simply the use of formative assessment and feedback, but the quality of those items that is important, (Hattie, 2008).

Portfolio and ePortfolio

Portfolio assessment is used in a variety of ways. Very generally, a portfolio used for assessment would be a collection of evidence that indicates a learner's mastery of the learning objectives. Portfolio assessment is identified as a form of authentic assessment (Keefe & Jenkins, 2002) where students select and discuss products to submit as evidence for progress. This is compared to the way in which artists including actors and architects might compile a portfolio showing the type of work they typically do in order to highlight their capabilities.

Renwick (2017) writes that as an assessment tool there are three basic types of portfolios: performance, process, and progress. He defines a performance portfolio as a student selected collection of work. That work is presented as evidence of accomplishment and includes student discussion and reflection about the learning. The process portfolio is a collection of work that includes versions of drafts of the work. The intent is to show the manner in which the student has processed through the learning to arrive at the final product. The progress portfolio is a teacher-managed collection of student work. This portfolio is used to show student development in a course over time.

Renwick (2017) further describes that any of these types of portfolio could fall into two the categories: best-work portfolios which are student driven or growth portfolios which are teacher driven. The best-work portfolio is a compilation of work that the learner selects to represent their achievement. This type of portfolio is student-centered because the student has determined what products show their achievement. A growth portfolio would be a sequence of longitudinal products that the teacher uses to determine progress (Renwick, 2017). McMillan & McMillan (2008) describes similar categories of portfolio claiming there are four types: showcase/celebration (best work), documentation/working (scrapbook), growth (change in proficiency), and evaluation.

Use of a portfolio can facilitate formative assessment (Marzano, 2011). The portfolio can be a tool that allows for feedback for the learner that includes feedback from instructors, peers, and the learners themselves. That feedback can help inform future work and future progress (Acosta & Liu, 2006; Jenson & Treuer, 2014).

Renwick (2017) and McMillan & McMillan (2008) define the types of portfolios as based on the type of artifact placed there, how the artifacts are selected, and what the

purpose of the portfolio is. Each of these types of portfolio could also fall under two main descriptors, static and dynamic. The traditional paper portfolio is a static portfolio. The historical use of portfolios began with English and Language Arts classes where students were compiling artifacts and samples of their work to act as a record of achievement or growth (Yancey, 1999, 2001; Rate, 2008). A good portion of the early literature about established portfolio practice discusses the use of portfolios in language arts classes as tools to promote gains in reading and writing.

Language arts classes and the teaching of writing are good areas for the use of portfolio assessment. Having a collection of student work highlighting certain skills or showing progress in using proper writing strategies could enable teachers to get a much better picture of where students are and what areas still need work (Yancey, 1991).

Portfolio assessment has also been established as a standard practice in arts education (Dunbar-Hall, Rowley, Brooks, Cotton, & Lill 2015). These portfolios are also designed to show growth and progress in a field. Additionally they can be used to clearly demonstrate ability and achievement and are commonly used in the college admissions process for students pursuing the arts (Dunbar-Hall et al., 2015).

Typically, these types of portfolios are static and contain one type of product, a written sample or performance piece (Rate, 2008; Rossi et al., 2006; Yancey, 2001). Even when used by other disciplines the traditional portfolio tends to be a static representation of what the learner has completed (Rate, 2008). The use of technology can extend the reach of the portfolio to include audio, video, external sources, and other types of products (Jensen & Treuer, 2014; Love et al., 2004; Rossi et al., 2006).

ePortfolio

The ePortfolio is claimed as having been first defined and proposed for use by Treuer at the University of Minnesota Duluth in 1994 (Jensen & Treuer, 2014). That proposal went beyond a course-based assessment tool and suggested an ePortfolio be used by learners as a way of documenting their learning across and between events (Jensen & Treuer, 2014). An ePortfolio is a digital extension of a physical portfolio that is web-based and is a student-curated collection of artifacts and related reflections (Enyon & Gambino, 2017; Stefani, Mason, & Pegler, 2007). An ePortfolio should also include reflective annotations and commentary about the artifacts and the ongoing work of the learner (Stefani, Mason, & Pegler, 2007). The reflective piece of the ePortfolio is an important aspect that is facilitated by the dynamic nature of a web-based repository of work. As artifacts are added to an ePortfolio they can easily be linked to earlier artifacts for a particular study, external resources, or even with events from a different course. The electronic nature of the portfolio means that it is much easier to change and curate (Jensen & Treuer, 2014; Stefani, Mason, & Pegler, 2007; Yancey, 2001). Jensen and Treuer (2014) discuss the need for specifically defining the e-portfolio. Their definition indicates that it is a tool for documenting one's own learning. They also suggest that the e-portfolio should be learner focused and used by the learner as a lifelong reflection of progress. Their research indicates that while this would be the goal of institutions implementing e-portfolios, the reality is that most learners use the portfolio only when required and do not extend the use of the portfolio outside of the formal learning environment (Jensen & Treuer, 2014).

An e-portfolio offers an alternative in that it allows for a dynamic portfolio that is an ongoing narrative about student progress. Students can easily update and add to evidence that has already been placed in the portfolio as they make additional progress. A learner does not need to be as selective when choosing artifacts because of this (Yastibas & Yastibas, 2015). For example, if a piece of writing is selected to exemplify a certain style and then later an additional piece of writing is created that is a better example it can easily be exchanged for the original artifact or can be added as evidence of the development or growth of the style. The exchange or addition could include a reflection about why the change was made. In addition, as pointed out by Jimoyiannis (2013), an e-portfolio is a dynamic space which can be managed by the learner using Web 2.0 tools to include collaboration and sharing. Jimoyiannis (2013) identifies that the e-Portfolio is different than a traditional portfolio because a traditional portfolio is the product of learning and an e-Portfolio also represents the process of learning. The learner-centered nature of the ePortfolio makes it an effective assessment tool for personalized learning and inquiry (Rate, 2008; Rickabaugh, 2016).

ePortfolio Implications

There are two general pushes for the use of ePortfolio. There are course specific applications and programmatic applications (Buyarski et al., 2017; Scully et al., 2018). Course specific applications are where the ePortfolio is used either as an assessment tool or as one aspect of recording student progress which is the case in this proposed research (Rate, 2008; Renwick, 2017; Yancey, 2001). Programmatic applications are implemented by academic institutions to record cross-curricular and extra-curricular learning experiences (Appling, Dippre, Hembree, Kooi, Carson, & Avery, 2015; Jensen & Treuer,

2014; Rossi, Magnoler & Giannadrea, 2008). The Association of American Colleges and Universities designated the ePortfolio as a high-impact practice (HIP) in 2016 (Watson, Kuh, Rhodes, Light, & Chen, 2016) and other research has shown the ePortfolio to be supportive of learning as a learner-based authentic assessment (Buyaraski et al., 2017).

Both programmatic and classroom application generally meet the objectives of the ePortfolio initiative that are set forth which include student engagement, motivation, and achievement (Jensen & Treuer, 2014; Rate, 2008; Renwick, 2017; Rossi et al., 2008). While ePortfolios seem to hold promise in all aspects of student-centered learning they are not widely used by educational programs or by individuals (Jensen & Treuer, 2014; Rossi et al., 2008). Generally, learners use ePortfolios when instructed to do so and the extent to which they engage with the ePortfolio content seems to be based on the emphasis that the instructor places on the ePortfolio (Appling et al., 2015; Rate, 2008; Rossi et al., 2008). The programmatic success of ePortfolio is directly related to individual instructor buy-in which was the same predictor of success for paper-based portfolio programs (Appling et al., 2015; Rate, 2008; Rossi et al., 2008; Scully et al., 2018).

As with other implementations of technology, the adoption of ePortfolio has not been widespread. Even more than two decades after Treuer defined the ePortfolio and designated its potential as an ongoing record of learning and progress, ePortfolios remain a minor influence. The field of ePortfolio pedagogy is still in its early phases (Nichols, 2008; Rhodes, Chen, Watson, & Garrison, 2014). The path to widespread adoption and cross-curricular implementation is through the learners. Instructors and learners will only adopt ePortfolios if they see some advantage to doing so. Learners often only use an

ePortfolio when instructed and only use the aspects they are instructed to use (Appling et al., 2015; Rossi et al, 2008; Siu, 2013; Stefani, Mason, & Pegler, 2007). Understanding the experience of the learner might lead to ideas about how to structure ePortfolios or the programmatic implementation of ePortfolios to support the learners and to make it evident that having a cross-curricular ePortfolio has advantages over not having one (Rossi et al., 2008).

Aspects of the learner experience using ePortfolio have been studied by some researchers, specifically the use of ePortfolio as an assessment tool focusing on feedback and reflection (Lewis, 2017; Mabry, 1999). The general content of an ePortfolio used for assessment of student progress in a course is artifacts, feedback, and reflection (Lewis, 2017; Mabry, 1999). In this format, reflection is a significant aspect of academic self-regulation (Zimmerman, 2000). A student creating an ePortfolio is being asked to reflect on aspects of their progress, success, and difficulty. Purposefully practicing self-reflection supports the development of that aspect of self-regulation and students who use self-reflection in developing ePortfolios are practicing that skill (Ayres & Paris, 1994; Cheng & Chau, 2009; Enyon & Gambino, 2017; Slepcevic-Zach & Stock, 2018).

Some research studies have approached specific tasks or aspects of self-regulation and self-efficacy to see if these attributes were influenced by ePortfolio practice. Yastibas and Yastibas (2015) analyzed studies about self-regulation and ePortfolio assessment. They found that ePortfolios specifically designed to increase aspects of self-regulation like goal setting would result in learners developing those skills. So, a purposeful application of the practice of self-regulation could support a learner's over all self-regulative skill. The ePortfolio of the physics class in the current study includes specific

elements to encourage goal setting and part of the purpose is to understand if students talk about that process as a specific part of their experience.

The research about ePortfolio assessment that centers on achievement also indicates other value-added aspects such as growth of self-regulative behaviors or changes in aspects of academic self-efficacy. Certificate courses with stringent standards like nursing programs have shown that ePortfolios can be used in conjunction with or in lieu of practicum exams and that they give additional benefit to the learners such as increased confidence and greater collaboration (Elbow & Bleanoff, 1986; Nash & Sacre, 2009). These ideas connect to the current study because they propose a link to academic self-efficacy and self-regulation that could act as a focus for understanding the learner experience.

Summary

The literature review focused on three main features. The fist was to establish academic self-efficacy and the related self-regulatory skills as the lens for the analysis of the data in this study. The second was to identify and explain inquiry and personalized learning as the primary pedagogical model for teaching science. The third was to show how ePortfolio is an alternative authentic assessment that supports inquiry and personalized learning. The final section also links the use of ePortfolio to the concepts of academic self-efficacy and academic self-regulation.

CHAPTER THREE: METHODOLOGY

Introduction

The proposed research is a basic qualitative study (Merriam, 2009; Merriam & Tisdell, 2015) to establish an understanding of the experience of learners creating an ePortfolio for the purposes of receiving a grade for a course.

Personalized learning requires a varied approach to assessing students (Rickabaugh, 2016) and the use of portfolios has been established as an effective method of alternative assessment (Ayres & Paris, 1994; Corso & Quaglia, 2014; Marzano, 1998). A portfolio used for assessment is a collection of student artifacts that include descriptions, discussions, or reflections about what those artifacts mean in the context of progress in a class (Love et al., 2004; Mabry, 1999; Rate, 2008). An ePortfolio has advantages over traditional portfolios because it is dynamic and can include a more extensive and interactive representation of learner progress (Love et al., 2004). Self-regulation, reflectivity, and goal setting are all aspects of ePortfolio (Love et al., 2004; Scully et al., 2018). Since an ePortfolio includes a reflective component, students working on an ePortfolio develop their ability to reflect on their progress that could enhance their ability to engage in self-regulated learning behaviors (Zimmerman et al., 1996). There is a close link between the process of self-regulative behaviors and self-efficacy (Schunk & Ertmer, 2000). These aspects are also part of the development of academic self-efficacy which has been linked to academic success (Zimmerman, 2000; Bandura, 1997; Pajares, 1996).

Statement of the Problem

The purpose of this basic qualitative study is to understand the experience of learners in first-year physics classes working with an ePortfolio as the primary method of assessment for that class. The lens through which the study will be conducted is academic self-efficacy and the related self-regulative behaviors.

The current and evolving approaches to education of personalized learning are based on constructivist learning theory (Friend et al., 2017) and involve strategies that are more strongly centered around the learner. These learner-centered strategies in education also call for changes in assessment. Standards-based grading and authentic assessment have been promoted as being supportive of learner-centered pedagogy (Marzano, 2004). Portfolios and ePortfolio are suggested as possible ways to facilitate standards-based grading and personalized learning. It is also suggested that an ePortfolio would be supportive of traditional grading procedures (Mabry, 1999; Yancey, 1999).

Even though ePortfolio assessment is believed to be an excellent tool for learning and assessment (Buyarski et al., 2017; Watson et al., 2016) and the proliferation of technology has made it possible for many learners to have access to this type of assessment, the practice has not taken hold to any significant level (Love et al., 2004; Scully et al., 2018). Upper-level science courses such as physics often require students to maintain a laboratory notebook which is a type of portfolio (Collins, 1991; Johnston, Kant, Gysbers, Hancock, & Denyer, 2014). Electronic lab notebooks (ELN's) can serve as the space for the creation and curation of an ePortfolio (Johnston et. al. 2014), even though they do not have all of the utility of dedicated ePortfolio applications. It is common for high school science courses to make use of laboratory notebooks for the

explicit purpose of keeping an ongoing record of laboratory work and that is the case for the physics classes at the research site. Electronic formats allow for these notebooks to also be generated digitally. An electronic lab notebook would be considered a presentation portfolio that was used as a record of ongoing work in a subject.

This research focused on the experience of creating the ePortfolio as the main assessment in a physics high school course and to seeks to understand how students describe that experience. Analysis for this work took place through the lens of academic self-efficacy and self-regulation. The intent was to understand if specific parts of the experience indicated a connection between student feelings about using ePortfolio as the assessment tool for the course and the development of academic self-efficacy and the use of self-regulation.

Research Questions

There is one central question that is the focus of this study and two sub questions. The central question is very broad and addresses the overarching purpose of the study (Cresswell, 2015).

The Central Question (CQ) was addressed through the lens of academic self-efficacy and the related self-regulative behaviors. The sub-questions (SQs) address these aspects specifically and were used to create a framework for answering the CQ

Central Question (CQ):

- CQ: How do high school students in a physics class describe the experience of using an ePortfolio as the major assessment tool of that class?

Sub-Questions (SQ):

- SQ1: What aspects of academic self-efficacy do students talk about when relaying their experiences of ePortfolio practice?
- SQ2: What self-regulative behaviors do students discuss when talking about their use of the ePortfolio assessment?

The sub-questions indicate the lens through which the student experiences were analyzed. As in any study following a qualitative design, the sub-questions were open for revision or expansion based on indications that might have occurred during the collection and analysis of the data (Bloomberg & Volpe, 2019; Cresswell, 2015). Changes were not deemed be necessary during the analysis of the data.

The value of the sub-questions in this study is to provide an in-depth analysis of the student experience using the lenses of the study. The sub-questions then provide an underlying structure for the central question. In the interviews and written responses, the participants provided context to how they described their experience.

The aim is to understand the experience of a learner being required to produce an ePortfolio for the purpose of being assessed in a physics course. This research is based on the idea that some aspects of generating an ePortfolio are supportive of self-regulated learning behaviors (Zimmerman, 2000) and that the process of producing an ePortfolio also involves intentional cognitive acts that support a learner's feelings of self-efficacy (Bandura, 1997).

Research Design

The design of the study is a basic qualitative study design (Merriam, 2009; Merriam & Tisdell, 2015). A qualitative approach is used in this research because the goal is to understand, from the students' points of view and voices, the experience of the

learners who are engaged in this alternative form of assessment (Bloomberg & Volpe, 2019; Cresswell, 2013). The reason for the basic design is that this particular study has a broad scope (Merriam, 2009), to use the academic self-efficacy and self-regulative framework to explore students' perceptions of their experiences using ePortfolios.

Experts in the field of self-efficacy have suggested adding qualitative studies to the body of research (Bandura, 1997; Pajares 1996; Usher & Pajares, 2008b). Pajares (1996) reviewed the significance of the research that indicates the performance connection of academic self-efficacy beliefs and recommends ways to expand the research to gain a better understanding of the relationship and sources of self-efficacy. Pajares (1996) suggests adding qualitative research to more fully understand the cognitive process of self-efficacy. More recently, Usher and Pajares (2008b) discussed new methods of inquiry and proposed that qualitative research could help broaden and deepen understandings of academic self-efficacy. For example, a qualitative inquiry could provide information about how two students with similar self-efficacy beliefs might react differently to setbacks (Usher & Pajares, 2008b). This difference in reaction might be observed by the use of reflective questions that directly ask students to discuss setbacks. This is also one of the questions that was probed during the semi-structured interviews for this research.

Educational researchers have already established that qualitative research is appropriate for self-efficacy research. Usher (2009) stated that quantitative analyses had left gaps and qualitative strategies should be used to improved understanding of self-efficacy. Her mixed-methods study about academic self-efficacy for math used interviews to evaluate middle school students. This method provided insight into family

and peer influences on mathematical self-efficacy beliefs. Wang and Neihart (2015) used a qualitative method with semi structured interviews of twice exceptional students. The research revealed rich data about students' perspectives about perceived capabilities and how they arrived at those perceptions. Zimmerman and Martinez-Pons (1990) used a mixed-methods study to explore difference in self-regulated learning. The qualitative data was collected through structured interview and a "strategy frequency" scoring procedure used. The results combined to form a picture of self-efficacy and strategy use among different groups.

In the field of ePortfolios there is a push for increased research of all types (Bryant & Chittum, 2013; Rhodes et al., 2014). It may seem that the proposed qualitative study to understand the experience of learners producing an ePortfolio could be described as research that is geared toward "feelings" (Bryant & Chittum, 2013). However, the theoretical framework of self-efficacy and self-regulation put it in the category of research that represents the need for studies with perspective. As noted in both Bryant and Chittum (2013) and Rhodes et al. (2014) there is a need for research that puts the ePortfolio in context and that seeks to understand how an ePortfolio might impact learning. Using the lens of self-efficacy and self-regulation will enable an analysis of how the ePortfolio interacts with the processes of learning.

Context

The participants were students in an introductory physics class in a large high school (2000+ students) in a suburban school district in the Northeast area of the United States. In this school district there are three high schools, five middle schools, and twenty-three elementary schools. The district serves a total of 28,000 students.

The school district place initiated a 1:1 computer program in AY 2014/2015. The goal of the program was to improve student access to technology. As part of that program the district also started a pilot of personalized learning strategies in AY 2017/2018. This pilot included teams at ten elementary schools, two middle schools, and one high school. The physics program at the research site participated in this pilot and implemented strategies and aspects of personalized learning such as project-based learning, authentic assessment, ePortfolio, and standards-based grading (Rickabaugh, 2016; USDOE, 2017).

The research site is a traditional high school with four grade levels (9-12) with a largely college preparatory program. The school has fifteen percent of the students qualified for free and reduced lunch. About thirty-five percent of the students are identified as belonging to a minority group and about fifteen percent of the students have a first language other than English. About ninety percent of the students enroll in post-secondary education and the graduation rate is around ninety-six percent.

At this school there are six full-time physics teachers that teach different types of physics courses. During the academic year of the study there were four first year (introductory) physics courses and four second year physics courses. The first-year courses were: AP Physics 1, Intensified (honors) Physics, Regular Physics, and Principles of Physics (conceptual-based). The second-year courses include: Astronomy, AP Physics 1, AP Physics 2, and AP Physics C (calculus-based). One course, AP Physics 1, can be selected as a first- or second-year course. Three of the second-year courses are AP sections which meet for the total of two periods (90 minutes) per day, five days a week. Astronomy is coded as a second-year physics course and must be taught by a certified physics teacher. This course is a non-AP class and meets for only one period per day (45

minutes). This distribution of courses is representative of the course offerings each year for the past 5 years. About seventy five percent of the students at this high school take a physics class and about fifty percent choose a second year of physics.

This study was drawn from a first year Regular Physics class that had a total of twenty-seven students. The syllabus of the course specified that the method of assessment was a standards-based ePortfolio and that the focus is on personalized-learning and inquiry.

The physics program focused on creating opportunities for students to engage in active inquiry and to specifically address aspects of designing experiments, collecting and analyzing data, and using graphical representations to form meaningful conclusions about physics concepts. There was also a focus on collaborative problem solving and demonstrated facility with mathematical and conceptual solutions. The inquiry, problem solving, and collaboration were reinforced through periodic project-based learning. All of the physics classes required a lab notebook for storing data and taking notes. Teachers had also begun exploring digital note taking strategies and electronic lab notebooks (ELN). The class in the study used an ELN for all aspects of the course. This lab notebook was used in conjunction with Canvas an LMS. The ePortfolio was created as part of this combination of the ELN and LMS.

ePortfolio

It is important to include in the context of the study a description of the ePortfolio. The ePortfolio for this study is defined as a web-based learner-centered assessment portfolio (Love et al., 2004, Rate, 2008; Scully et al., 2018). Sources referring to ePortfolios were included in Chapter 2 and a description of the of the ePortfolio for this

class was included in the Definition of Terms in Chapter 1. In addition, several examples of student ePortfolio pages and the description of the ePortfolio requirements from the course syllabus are included in APPENDIX C and APPENDIX D.

This was an assessment ePortfolio which indicates that the purpose of using the ePortfolio was to provide an assessment to the students. The course was divided into learning modules or units. These modules followed a typical traditional physics course and were aligned with the Standards of Learning of the state Department of Education. Each module had the typical types of learning activities for a physics course: Laboratory work; inquiry activities; problem solving; independent and group projects; assessments; and class discussions about physics topics. Students engaged in these activities on an ongoing basis. The aspect of the course that was different was that instead of receiving the grade from the day-to-day work, the students selected examples from that work to include in their ePortfolio. That process allows for the day-to-day work to be used as a method for giving feedback to students about their progress. Each assignment completed resulted in feedback from the teacher. Regardless of the feedback, students could use the assignment as an 'artifact'. Sometimes students would use an assignment they had been unsuccessful on in order to show progress in some area.

Students could use any aspect of their work as an artifact and could present it in the way that worked the best for them. The most common ways to submit an ePortfolio was on Canvas (LMS), GoogleDocs, or on LabArchives. Each of these had advantages and disadvantages for the student and all were equally accessible for the teacher. The types of artifacts students would submit were spreadsheets and graphs, text documents, pictures of work, digital drawings, screenshots, and videos. Each of the artifacts was

accompanied by a description of why the work was used and a reflection about what it showed about the seven science practices that were the assessment standards used for the class. The standards were derived from the Seven Science Practices of the College Board intended for AP® Science classes. There were some required elements included in the ePortfolio each quarter and for each module. Some of those are listed in the syllabus document in APPENDIX C. Examples of student ePortfolios in physics are included in APPENDIX D.

Participants

The participants of this research were first-year physics students enrolled in physics classes that use ePortfolio as the central assessment method. There were twenty-seven students from a first-year, non-honors class. The course used ePortfolio as the central assessment method and all of the students were invited to participate in this study.

The data were from the completed third quarter ePortfolio. After grades were assigned the parents and students were informed about the research and asked to provide informed consent for the completed and evaluated data to be used in the analysis. The researcher explained that participation is voluntary and guarantee that no penalty would occur for students who did not want to participate. Parent consent and student assent were obtained before using any of the data for the study.

This physics class was part of the school SBA pilot and utilizes an ePortfolio as the major assessment tool. All of the students were evaluated using the same methods and required to complete the same activities. Each student completed an ePortfolio and all ePortfolios had the same requirements. Students participated in individual student-teacher conferences to communicate about progress in the course and work in the ePortfolio. The

same types of data were produced and collected from each student. The only difference was that the data from the students who agreed to participate and who had parental consent was analyzed in this research.

Sources of Data

The data for this research were collected directly from the established ePortfolio process. The primary group of data was the written responses to reflective prompts about the ePortfolio and academic aspects of the course. These prompts were contained within the portfolio and were a component of the ePortfolio process itself. The second data set was from semi-structured interviews about the course in the form of a student-teacher individual conference. These were contained within the established practice of student conferences that were used throughout the year to discuss progress and to establish two-way feedback about the student experience.

The reflective prompts and the interview questions used for the academic year included questions designed using Bandura's (2006) guidelines for conducting self-efficacy scales APPENDIX A. The goal of using these guidelines was to focus the reflection on self-efficacy while maintaining the prompt for an open response to get at the learner's thoughts about the process and how they feel about the development of their capabilities.

Reflective prompts were embedded in the ePortfolio and the responses to the questions were part of student self-evaluation of their progress in the ePortfolio. These questions were derived from three other sources : The Physics Self-Efficacy Questionnaire (PSEQ), the Self-Efficacy in Physics survey (SEP), and the Sources of Self-Efficacy in Science Courses – Physics (SOSESC-P). Once the questions were

developed by the researcher/instructor they were shared with other members of the school-based standards-based grading pilot for comments and suggestions. The questions were revised after feedback was considered. Since this was part of the course evaluation, the questions were used in first quarter ePortfolio. The questions were further revised for clarity based on the length and type of response from students. That process was done in collaboration with the school-based team as well. One of the considerations in revising the questions was to increase the qualitative value of the student responses. The questions embedded in the ePortfolio were updated to the revised questions and were used for the remainder of the year. The reflective questions are shown in Table 3.1.

Table 3.1 Reflective Prompts

Reflective Questions
(1) Describe how you feel about the process of creating an ePortfolio.
(2) What part of the ePortfolio process was most useful in your learning? Explain why.
(3) What part of the ePortfolio process was least useful in your learning? Explain why.
(4) When you read through your ePortfolio, how do you feel about the work you have done?
(5) Tell me something else about your experience of working with the portfolio that you think it is important for me to know

As indicated before, the other data were collected from a series of semi-structured interviews with students. These interviews were within the end of quarter student-teacher individual conferences. Each student had at least one conference per quarter. The time for each conference was between 10 and 20 minutes. The interviews were semi-structured as in Usher (2009) using the protocol set by Zeldin and Pajares (2000) for interviewing

students about academic math self-efficacy. As mentioned by Usher (2009), a semi-structured interview lines up with theoretical constructs but is not bound to them so that it allows a researcher to ask for clarification and to probe deeper into how the respondent is feeling or thinking. The format of the interview was informal conversation which included general questions about the student and more specific questions about the topic of the ePortfolio (Usher, 2009; Zeldin and Pajares, 2000). The list of questions was developed using the same resources as the written prompts. These questions were also shared with the members of the school based SBG pilot for feedback. After considering the feedback and discussions with the members of the pilot a final list of questions was developed. The questions are listed in Table 3.2

Table 3.2 Semi-structured Interview Questions, Quarterly Conferences

General Academic and Personal Well-Being

- How was your third quarter over all in school?
- What activities did you have outside of academics?
- Do you do most of your homework at home or during Patriot Period? (study hall)

ePortfolio Reflection

- How do you feel about your ePortfolio this quarter?
- How would you describe the process of having an ePortfolio be your central assessment for the class?
- What makes using an ePortfolio different than being graded in a more traditional manner?

Future goals

- Thinking about your ePortfolio, what might you do differently during fourth quarter?
- How would you feel if you found out your college required an ePortfolio for all classes?
- How confident are you that you will be successful in this course moving forward?

Data Collection and Management

The participants in this study were students enrolled in physics classes at a large high school (2000+ students) in a suburban district in the Northeast area of the United States. At the beginning of the school year, the students and parents received the syllabus which explained standards-based grading and the ePortfolio assessment system. It was noted that self-evaluation and conferences were part of the general operation of the class and that those aspects were administrative in nature and were not part of the class grade.

The third quarter self-evaluations and conferences were the sources of the data for this study. The reasoning behind this decision was based on several factors. The primary factor was that this gave the students two previous quarters to work with the ePortfolio system and to help ensure that the responses were not influenced by the novelty of the experience. It also gave the researcher as participant-observer time to build trust and to provide meaningful feedback to the first two quarters of student responses to help guide them in providing quality written responses to the reflective questions and to feel comfortable discussing their experience. The ePortfolio is a cumulative collection, so the third quarter curation would include the artifacts and feedback from the first two quarters of the year. The final portfolio was not planned for use, because approaching the final submission students may not be as candid about their feelings. In addition, at the end of the school year the academic schedule becomes more fluid because of AP exams, state mandated exams, and extra-curricular events that result in changed or shortened class schedules which might have interfered with adequate time for extended interviews.

The researcher in this study was a participant-observer in that he was the instructor for the course. This fact afforded some insight into the collection of the data as well as presenting some inherent challenges. A further discussion of the participant-observer status is in the Limitations section of this chapter. The interviews were planned to follow the normal administrative practice of the course which would be ten to fifteen-minute sessions during the school day usually during class time. As a result of Covid-19, the school changed to a virtual platform on March 13, 2019. This was three weeks before the end of the quarter. Courses were changed to completely asynchronous with short office hours during the school day. As a result, the quarterly conferences (interviews)

were conducted via Zoom instead and students signed up for thirty-minute time slots which were kept within the confines of the school ... This had the effect of several of the sessions lasting up to twenty-five minutes, as the beginning of the interview intending on establishing rapport and checking in with the students was extended.

To remove the implication that participation would have any influence over the outcome of the grade students were not recruited for the study until after the third quarter grades were part of the official record. For the original plan, a presentation was to be given to the students about the research. A letter was to be given to the students and the parents about the study and to ask for informed consent for participation. The students would return forms to the school to one of the other physics teachers who would hold the forms until after the school year was complete and the grades were part of the permanent record.

Due to the onset of Covid-19, the school district was closed for in-person instruction on March 13th. The students completed the rest of third quarter virtually and the official end of the grading year was April 3rd. The final grades were submitted and made official in the same time frame. Participation was recruited via email, Canvas announcements, and Remind (messaging app), following a slightly shortened timeline. The consent forms were delivered virtually and parents could return them electronically or through the mail. All forms were still maintained by a different physics teacher until after the end of the school year and the point at which grades were made an official part of the record. It was made clear that agreement to participate meant an agreement to allow the individual student data to be analyzed for the purpose of this study.

One other change occurred due to the school switching to virtual instruction for the last two weeks of third quarter. That change was that the third quarter conferences were held virtually using Zoom. Conferences were normally recorded to facilitate conversation without the teacher being distracted by taking notes during the interview. As per directive of the school district, all 1:1 meetings held virtually during the closure were to be recorded by the teacher/researcher and saved as a matter of record. The Zoom sessions were recorded with video and audio using the meeting software and saved by the instructor. To follow the original classroom practice, an additional audio recording was made using a VoiceRecorder app on an iPad. That file was uploaded to a MacBook and saved as an audio file.

After the school year ended and the grades were made final, the physics teacher colleague forwarded the file containing the digital collection of the permissions and a spreadsheet was made identifying the students who had agreed to allow their data to be used along with their student information.

The file containing the written responses was downloaded. The nonparticipants were eliminated from the file. Pseudonyms were applied to the spread sheet and the student name was removed. This file was saved and then uploaded to NVivo, a digital qualitative analysis application. The audio files of the semi-structured interviews were renamed with the pseudonym and each was uploaded to NVivo. Each file was transcribed by the researcher in NVivo. In one case the audio file from Zoom was also used to get a more complete recording.

Data Analysis and Procedures

This research is a basic qualitative study (Merriam, 2009; Merriam & Tisdell, 2013) using written responses to reflective questions and verbal responses to semi-structured interview questions as sources of data. The purpose of the study was to understand the experience of learners in a first-year physics class working with an ePortfolio as the primary method of assessment for that class

The written response data were analyzed using an initial set of *a priori* codes (Saldana, 2016; Miles, Haberman, & Saldena, 2014). This method was selected in order to facilitate the analysis of the responses through the lens of academic self-efficacy and self-regulation. This method is similar to that used by Usher (2009) in a qualitative study on sources of mathematics self-efficacy. In order to use this method a provisional list of codes is developed that matches the theoretical framework (Miles & Haberman, 1994). The theoretical framework of this study is academic self-efficacy and the related academic self-regulated behaviors. The codes that were created mirror the underlying structure of factors that influence the development of academic self-efficacy which include self-regulation (Bandura, 1986a).

The codes were under two general categories, academic self-efficacy and self-regulation. The codes were based on aspects of each of these categories. The codes for self-efficacy were **modeling, mastery experience, use of feedback, and outcome expectancy**. The codes for self-regulation were **engagement in task, planning, motivation, and reflection**. These codes are a partial list of aspects that may be influential in the development of self-efficacy in adolescents (Pajares, 2006).

The initial coding of the data was performed using structural coding which uses the research questions to select sections of data and then uses the selections of data to guide further analysis (Saldana, 2016). This type of coding is supportive of the analysis of interviews and open-ended survey results. During the initial coding of the data the codes were open to modification or expansion based on what the first round of data analysis provided. This list was not exhaustive and was meant to frame the coding with the lens proposed by the study (Saldana, 2016; Miles et al., 2014).

The interviews were semi-structured to allow flexibility in the responses and probing of responses (Merriam, 2009). The same provisional codes were used for analyzing the interview data. For this data set it was important to capture the voices of the learners to understand their experience. In order to accomplish this goal, *in vivo* coding was used to further define the preliminary codes (Saldana, 2016

After a portion of both sets of data were coded with the preliminary *a priori* codes, the codebook and samples of the coding overview were shared with two advisors with research experience as suggested by Saldana (2016). Their feedback indicated that the assignment of the data was unclear and some of the data did not appear to fit the code definition. Provisional coding starts with an initial set of *a priori* codes which can be adjusted, deleted, or changed to better represent the data (Saldana, 2016; Miles et al., 2014). At that point, it was apparent that the *a priori* codes may have been too restrictive. The first cycle coding was maintained as a preliminary analysis and alternative methods suggested by the advisors were considered.

The first was to remove some of the written responses from the analysis. Question 2 and Question 3 are prescriptive questions which imply a defined aspect of the

ePortfolio that was useful and a defined aspect that was not useful. The point was made that these questions were more about the ePortfolio and not about the students' experience. This suggestion was considered but not taken as some of the students had elaborated on these questions and had included information that seemed pertinent to their personal experience. The suggesting was also partly resolved in the additional processes described below.

The second was that I might consider thinking about the data as by participant first and then return to an analysis by question and by data set. As a preliminary exercise I separated the written responses for two students and paired them with the transcripts of the interviews of the two students. Reading over the two data sets I noticed that there were data that seemed important about the student experience, but that had not been included in the first-round coding. At that point I realized that using a deductive approach was resulting in a skim of the data to find samples that matched the *a priori* codes and this was limiting the analysis. I decided that I would set the *a priori* codes aside and move toward a more inductive approach. With the first two participants I used descriptive coding with the goal of trying to use their responses to create a narrative overview or experience profile about the learner's experience based on their words. I noticed that a patten of analysis was emerging from that process. I produced a total of five experience profiles and shared them with the advisors. From their feedback I adjusted the profiles to contain three sections: An overview of engagement, learner experience, researcher interpretation and analysis. In addition, some of the students' direct words were used in the learner experience section as *in vivo* codes.

An iterative process was created to generate the narratives. The transcript for each interview was isolated. The transcript was compared to the written responses to see if any common ideas were expressed. The transcript was read while listening to the recorded interview to note the tenor, tone, and cadence of the student voice. Notes were made on the transcript about pauses and other speech patterns to help give context to the words the student was speaking. The transcripts with notation were compared again with the written responses. The interviews were listened two a second time to get a general sense for the confidence and mood of the student. Finally, experience profiles were written for each student following the model described. After the profiles were completed the learner experience sections were analyzed and additional codes were produced which included *in vivo* coding. The coded data was reviewed and organized using NVivo 12. A third cycle of coding was *in vivo*, which specifically used the interview transcripts and written responses to highlight the voice of the participants (Saldana, 2016). After the second and third cycle of coding, the codes were analyzed to see if themes or general groupings emerged. It was determined that there were two overarching categories of codes: process-based or learner-based. Process-based data was the part of the student experience focused on the process of producing the ePortfolio. Learner-based data was the part of the experience focused on the student as a learner. The coded data was defined and regrouped based on whether it was process-based or learner-based.

In the interviews and written responses, the participants provided context to how they described their experience The basic division of student experience was to talk about themselves as learners and to talk about the process of completing an ePortfolio. This made it evident that the learner-based codes generally could be considered related to

academic self-efficacy and the process-based codes could be considered related to self-regulation. The third aspect that emerged was an affective-based theme about academic stress which is addressed in the analysis of the CQ.

Themes:

After generating the narratives, the new list of codes was defined and a new codebook with descriptions was produced. The list of codes was taken as a whole and compared with data that had been coded under the *a priori* codes in the initial coding attempt. What I noticed was that I had selected similar passages both times and in the first case had assigned them to an *a priori* code and in the second had assigned them to a new descriptive code. I noticed three themes.

One was the ePortfolio and the other was the learner. The first theme was students discussing the process of making the ePortfolio which included descriptions of how it was accomplished. For example, describing how they worked on it, chose artifacts, or designed a plan to complete it. The second theme was students talking about themselves as learners. For example, the students would describe how they felt about their work, their achievement, or themselves as learners. There was a third emergent theme that I had not thought about which was an affective theme of academic stress. I initially thought it might be included as the theme of the learner, but it seemed to be more distinct and often students discussed it in isolation of the other two themes.

On further analysis of the coded data, I determined the original *a priori* codes actually should serve as sub-themes of the data. On that realization, I also determined that the new themes should be designated as Self-Regulation and Academic Self-Efficacy. A

table showing the codes and themes is included in APPENDIX E and Figures 4.5, 4.6, and 4.7. An abbreviated list of sub-themes is on Table 3.3.

Table 3.3 Themes and Sub-Themes

Theme	Sub-Theme
Self-Efficacy	Mastery
	Modeling
	Outcome Expectancy
	Use of Feedback
Self-Regulation	Awareness
	Reflection
	Planning
	Motivation
Academic Stress	Academic Stress

Ethical Considerations and Limitations

As pointed out by Bandura (2006) it is important to remove social pressure when assessing self-efficacy. In this research a significant ethical consideration and limitation was that the researcher was also the instructor for the course. As a participant-observer, it was important to make clear that participation was optional and that is had no effect on the student's grade in the course. Some of the participants were under 18 and parental permission needed to be granted for each portion of the study. In the communication with parents and students it was noted that it might be possible that not all available data would be used in the study. Therefore, no student (participant) would know for sure their data was reflected in the final analysis. Since the data consisted of only nongraded

portions of the class and was not compiled until after the academic year had been completed and the final grades had been submitted there was no additional risk posed by agreeing to participate.

An additional limitation posed by social pressure as discussed by Bandura (2006) is that the students may have responded to the reflective questions in a way that they believe could help improve their grade and may be more guarded in their responses rather than candid. They may have also given responses that they thought pleased the instructor rather than make critical judgments about the ePortfolio process. The pressure existed even though the students were unaware that their responses might eventually be used as part of the study. The desire to please the teacher and get a good grade were separate from the research study. This limitation was mitigated somewhat by using the responses from the third quarter of grading so that the students had already received feedback on reflective responses from previous quarters. In addition, it was important for the instructor to be supportive of all responses in the first and second quarter and to provide feedback to encourage deeper discussion and critical analysis of the process.

Trustworthiness

As with any qualitative study there are concerns of the trustworthiness of the data (Bernard, 2011; Cresswell, 2015; Merriam, 2009; Merriam & Tisdell, 2013; Shenton, 2004). One important aspect of the trustworthiness of the study is that the researcher is a participant-observer (Bernard, 2011; Cresswell, 2015) as the teacher of the course. While there is a potential for the students to supply erroneous data and for the researcher to ascribe meaning where there is none, the benefits of the participant-observer outweigh the potential for bias (Bernard, 2011). Several methods described by Shenton (2004) will

be employed to mitigate the impacts on trustworthiness. Triangulation of data by the use of multiple data sources is one method. The two sources of data, written and interviews, will be collected at two different times. In addition, the manner of collecting the data varies. The written responses to reflective prompts are part of a self-reflection that is embedded as a required task within the ePortfolio. The interviews are taken from the student/teacher conferences that are held at the close of each quarter as a source of administrative check-in on student progress. A second method that is employed is by including other researchers to perform a check on codes and data analysis (Merriam, 2009).

Shenton (2004) also suggests that trustworthiness can be improved by a recognition of a researcher's beliefs and assumptions and a recognition of the limitations of a study. Both of those methods were employed in this dissertation. A final method of increasing trustworthiness is the inclusion of a negative case analysis, that includes negative aspects of the participants' experiences (Shenton, 2004)

There are benefits of the participant-observer position. Having been an educator for twenty-eight years has given the researcher a significant amount of experience forming constructive relationships with students. A participant-observer who is established as a member of a community and who has significant time in the field can have a more intuitive understanding of how to get at the experience of the community members (Bernard, 2011). Having an in depth understanding of the research community and a researcher having a long relationship with the participants increases trustworthiness (Shenton, 2004). The experience of understanding how to talk to students and how to probe for deeper answers is important in this context. The participant-observer may also

intuitively know when a student has something else to say or is uncomfortable answering truthfully.

Summary

The methodology of this study is a basic qualitative model. The aim of the study was to understand the experience of a learner creating an ePortfolio. The qualitative analysis considers whether themes related to academic self-efficacy emerge from written responses and semi-structured interviews.

The participants in this study were first year physics students who were in a physics course where ePortfolio was the major assessment tool. The data was collected from two sources. The first one was the written responses to reflective prompts contained in the ePortfolio and the second one was the verbal responses to semi-structured interview questions. Participation in the study was not required. All of the students received the same instruction and participated in the same learning activities. In addition, all students completed an ePortfolio and were assessed through an evaluation of that portfolio which included the written responses and verbal interviews. The data used in the study was the interviews and responses from those students who agreed to take part. Parents' consent and students' assent were after the quarter had ended and the grades had been made permanent. The data was not compiled or analyzed until after the school year had ended and the final grades were submitted. Therefore, all of the data was considered historical data and had no further effect on the student or their evaluation.

The coding began with a deductive approach. *A priori* codes were used to start coding with a preliminary list. The first round of data analysis used structural coding to begin the analysis of the written responses to help guide the analysis toward the

theoretical framework of academic self-efficacy and self-regulation. It was expected that this partial list codes would need to be expanded or modified to fully encompass the data collected the codes were indeed changed slightly to accomplish this. In order to capture the experience or voice of the students, *in vivo* coding was used to analyze the verbal responses to the interviews as well as for the written responses.

Two additional researchers checked a sample of the coding after the first round to ensure that there were no additional codes present and that the codes developed were applied appropriately to the data. The researcher was a participant-observer which created both positive and negative aspects of trustworthiness. Those points were kept as important considerations in the analysis of the data.

The following two chapters will present the analysis of the data and the conclusion of the study. Chapter 4 applies the methodology discussed in this chapter to compile and analyze the data. I includes information about each participant and about the group as a whole. The data analysis is presented and the process of coding and generating themes is fully discussed. Visual representation of the data is given for each of the sub questions and for the central question. In Chapter 5, I present my findings to resolve the purpose of the study. I also connect my findings to research on ePortfolio assessment and about academic self-efficacy and self-regulation. This leads to a discussion on implications for K-12 education and suggestions for future research. Finally, I summarize the basic qualitative study and the resulting understanding of the experience of learners in first-year physics classes working with an ePortfolio as the primary method of assessment for that class

CHAPTER 4: FINDINGS

In K-12 there has been an ongoing shift away from traditional models of instruction toward learner centered and inquiry-based models (Miller, 2013; National Research Council, 2000). These models are the center of the push for what is described as personalized learning (Rickabaugh, 2016). The personalized learning model requires changes both in the manner in which students are instructed and how their progress is assessed (Marzano, 1992; Rickabaugh, 2016)

One method of alternative assessment is the use of an ePortfolio. ePortfolio assessment has been defined as an effective type of authentic assessment that is supportive of personalized learning (Mabry, 1999; Rate, 2008). A portfolio (or ePortfolio) used as assessment is a collection of learner-curated artifacts and associated reflections to represent the process and progress of learning (Rate, 2008). An ePortfolio additionally makes that representation interactive and dynamic (Jensen and Treuer, 2014; Scully et al., 2018).

The purpose of this study was to understand the experience of learners in first-year physics classes working with an ePortfolio as the primary method of assessment for that class. The participants were members of an introductory physics class at a large (2000+ student) suburban high school in the Northeastern United States.

In this study, the aim was to seek to understand the student experience using an ePortfolio as the primary assessment for an introductory physics class. There was one

central research question to frame the study and two sub-questions to provide a lens to focus the understanding on aspects of learning.

Central Question (CQ): How do learners in a physics class describe the experience of using an ePortfolio as the major assessment tool of that class?

Sub-Questions (SQ):

- SQ1: What aspects of academic self-efficacy do students talk about when relaying their experiences of ePortfolio practice?
- SQ2: What self-regulative behaviors do students discuss when talking about their use of the ePortfolio assessment?

The first section of this chapter provides a profile of the participants. This section is important because it gives context to the study and it helps to better understand each one of the students from whom the data was collected. This section includes a general description of the participants, a table of participants with a discussion of an overview of their data, and a general statement of the way each student described their experience.

The second section of this chapter presents a discussion of the data and analysis. This section includes salient responses by participants that were used in the description of the experience. Finally, this section includes the process of generating themes and coding responses.

The third section of this chapter provides an explanation of how the data and analysis addressed the research questions. This section includes an overview of the student background and establishes a general framework to understand the experience of using an ePortfolio.

Participant Profiles

From the class of twenty-seven students, there were seventeen total students whose data were included in the study. This included nine females and eight males. Their ages ranged from 16 to 17. Sixteen of the students were in grade 11 and one student was in grade 12. Four of the students were identified gifted in English, one was identified gifted in art, one was identified gifted in math and English combined, and no students were identified gifted in science. One student was receiving special education services as prescribed by a 504 plan. There were four levels of mathematical ability represented by the math courses the students were enrolled in: Algebra II, Algebra III, Precalculus, and AP Calculus (BC). Thirteen of the students identified as white and one of those students was an English language learner. One student identified as Hispanic, one student identified as multiracial, one student identified as Asian, and one student identified as American Indian. In this study, all of the students were assigned a pseudonym. Table 4.1 below indicates the students' pseudonyms, gender, age, and an overview of the context of their interviews and reflective responses.

Table 4.1 Participant Data

Pseudonym	Gender	Age	Overview of Engagement
Amanda	F	17	Amanda gave complete and descriptive written answers to the reflective prompts. They were directly related to the prompt and were detailed. During the interview she freely talked about her experience using an ePortfolio.
Beth	F	16	Beth gave long written responses to the prompts and answered each of the questions directly and with detail. During her interview she was very descriptive and was comfortable talking about her experience using the ePortfolio and her experiences in the class.
Bria	F	17	Bria gave very thorough and descriptive answers both in the written reflection and in the interview. Her written reflections in particular were very detailed. The interview and discussion touched on similar aspects of the ePortfolio experience focusing on flexibility and learner-centered features.
Erin	F	16	Erin gave complete and thoughtful answers on the reflective prompts and was very expressive during the interview. She included lots of details and comparisons between ePortfolio and traditional grading. She is an advanced student who had signed up to take AP physics as a follow-up course. She was serious during the interview and took several long pauses before answering.
Jane	F	16	Jane gave brief responses to the reflective prompts, while being open and descriptive during the interview. Her interview responses tended to be fairly self-directed about her experience and how the ePortfolio made her feel as a learner.
Karen	F	16	Karen gave very brief answers in the reflective responses. Her interview was more informative and direct. During her interview, she referred to the student conferences we had in previous quarters.
Samantha	F	16	Samantha was open in her interview and very expressive. Her written responses to the reflective prompts were very brief and did not include a great deal of detail. In both areas, she expressed using the ePortfolio to look back at her work and to help plan what work she would do moving forward.
Shania	F	16	Shania wrote very descriptive responses to the reflective prompts and was open and descriptive in the interview. Her responses in the interview were much longer than her written reflection and she included many details about how the learning process was influenced by the ePortfolio work.

Tina	F	17	Tina had extensive answers both in the written reflections and in the interview. She "loved" the ePortfolio. Her interview was very extensive and she provided important details. She talked a lot about how it supported her learning and helped reduce stress.
Austin	M	16	Austin's reflective responses and interview responses were brief and to the point. His interview for 3rd quarter also included a discussion of his second quarter ePortfolio because he had turned his second quarter ePortfolio in very late.
Chuck	M	16	Chuck seemed comfortable during the interview and talked very descriptively about his ePortfolio and gave numerous examples to explain his statements. He gave brief but specific responses to the reflective prompts. The details about his experience from the written reflection were filled in with his examples during the interview.
Donny	M	17	This student was expressive and descriptive in the interview and gave more brief answers in the written reflections. In both places, he expressed liking the ePortfolio and appreciated that it made him reflect on what he had done and gave him a chance to go back and look at his work.
Ed	M	16	Ed gave brief but direct answers on the reflection responses. His interview was difficult to transcribe because of the sound quality of the file caused by poor internet connection. The interview was fairly long and enough of his answers were clear enough to discern his statements about the experience.
Hakim	M	16	In the interview, Hakim spent a considerable amount of time asking procedural questions about the ePortfolio and he expressed concern about having everything done correctly. Several times he redirected questions about his experience back to seeking validation of his product. His reflective responses were more focused on the reflection and communicating a response to the prompts.
Jerome	M	17	Jerome was fairly self-reflective and thoughtful about the work he had done during the interview. His written responses were brief and to the point and he did not elaborate on his responses. He talked a lot about particular lab activities that he enjoyed.
Pete	M	17	Pete had brief and direct statements on the reflective prompts. His interview was complete and included informative details about his experience. During his interview, he provided additional insight into his experience with the ePortfolio.

Tony	M	16	Tony provided a large amount of information, both in the interview and written responses with a focus on reflection and connection while building the ePortfolio. He is one of the students who discussed the third quarter process as a growth process where he had started building the ePortfolio at the beginning of the quarter and was putting artifacts in as he went through the quarter.

This section of the chapter contains an overview of the participants and insights into how they engaged with talking about the ePortfolio in their written responses to reflective prompts and during the semi-structured interviews. The researcher in this study was a participant-observer since he was the instructor for the course. This fact afforded the researcher some insight into the collection of the data. The experience of discussing the portfolio had been established as part of the course and students may have been more comfortable by the third quarter of the year. The interviews were planned to be ten-minute sessions during the school day. As a result of the school closure because of Covid-19, the interviews were conducted via Zoom instead. This had the effect of several of the sessions lasting up to twenty-five minutes as the beginning of the interview intending on establishing rapport was extended.

One of the assumptions in this study that presented a particular challenge is whether the participants were open and honest in their interviews and written responses. An advantage of being a participant-observer was to have some insight into how students were responding and whether they seemed as though they were giving honest and thorough answers. This however would not give assurance and offers no direct evidence. To help discern honesty and openness several strategies were used.

One strategy was to provide a low-risk opportunity to give a negative response by a non-class related ePortfolio question. One of the questions included in the interview

was: “How would you feel if you found out your college required an ePortfolio for all classes?”.

This was as a generic question that was not directly related to the student’s current use of an ePortfolio. Since it was unrelated it might make a student comfortable to voice a negative opinion about ePortfolios without speaking about the one they were currently working on. For all students, the response to this question did not indicate any difference in opinion about ePortfolios than expressed in their full interview and reflective prompts.

Additional evidence of student openness and honesty was that written responses of each student had similar themes and statements as they expressed during their interviews. For example in her interview Tina stated, “So having the portfolio is a lot more helpful because I can demonstrate what I know” and in her written response she stated, “It shows me what areas I need to work on, and what areas I have demonstrated full knowledge in”.

Finally, an example of evidence that participants were open and honest was that they made statements about their performance and about the ePortfolio that had negative connotations. For example, Karen talking extensively about her lack of motivation and her opinion that the ePortfolio structure created a situation where she would do less work and procrastinate. Another example was Chuck writing, ‘I feel like I did well on the work but I think I could have done more of the complex experiments that were available”.

An experience profile was written summarizing the student interviews and written responses in the context of describing the experience for each student. During the construction of the profiles, direct student statements were selected from either the interview or written response that illustrated a central or important detail given by each

student about how they felt about their experience. Table 4.2 provides the student statements selected about an aspect of their experience using an ePortfolio as the central assessment method. The statements were selected because they were reflective of the content and tone of each student's combined written responses and interviews. This table gives a general sense of each participant's experience.

Table 4.2 Overview of Student Statements about ePortfolio Experience.

Pseudonym	Student Statement
Amanda	I think that it takes your learning, all of your learning, into consideration rather than just a few assignments
Beth	Tests tell a day the ePortfolio tells my work
Bria	I can go out and I can pick what I think I did better on vs what I think I didn't do as well on and show that to you and say this is what I did really well and then comment later that I want to work more on this.
Erin	I think I can show you if I have any gaps in my understanding. If I'm putting the portfolio together and I can't find something that covers a concept, then I think oh maybe I should take a look back at this.
Jane	When I have the explanations, even if they're brief, it really relates it back to the concepts and it forces me to think did this actually hit it and did I actually do anything that fits into the science practices.
Karen	My mind is very loose in some sense but I like grading to be a very rigid thing. So, the ePortfolio doesn't really work well for me. I mean it does make me aware of my failings or my shortcomings in regard to the work that I do. It is just a little bit too abstract in a thing that I like to be rigid.
Samantha	I like it because I can go back and see the things I did well and the things I have to work on. So, if I need to work on something more. If I take another physics class, I will know what I have to work on.
Shania	This way of doing it makes you think about yourself as a student more as opposed to just a grade. In other classes, I am doing this assignment to get a good grade and just move on. In the ePortfolio I am going to reflect on what I used. Thinking about how I learn best.
Tina	Easier for me to set goals. For example, I need to get this done and then I will put it in when I am done. And then after that I should do that assignment, it is definitely easier to put things in as I go and definitely easier if I set goals.
Austin	I remember what I did during the whole quarter. I actually went through and looked at some of the questions to make sure that they were good, and it wasn't just some b.s. work.
Chuck	I realized what topics I did well and the topics that I should try more on.

Donny	Better in physics. A better student. Organization is probably the main thing. Makes you feel organized and get organized. think it helps kids learn a lot more …we are trying to learn physics and get knowledge about physics instead of a grade.
Ed	I somewhat enjoy it because it gives me a chance to look back at what I've done.
Hakim	Having the choice of what to put and not to put made feel much better and made me do better work. I make decisions by seeing how confident I am like where like finishing this work, how it shows I learn physics. I think about what shows the physics... and what work affected me in a good way.
Jerome	Usually with normal assignments. You kind of do them and they go in the grade book and you don't have to think about them again, but this you are going to have to go back and use your old assignments. Going forward I am going to write them in a way that I am going to understand them better going forward.
Pete	The teacher doesn't grade you on like every single assignment you've done. Instead, you can say hey this is my best work, and this is work that I posted. This is work that I want to improve on.
Tony	You can see yourself doing the work and see yourself connecting the ideas making it look good.

Data and Analysis

This section discusses the data collected, the manner in which it was analyzed, the process of coding, and the themes that were generated through the analysis.

Two sources of data were collected. The first was the set of written responses to reflective prompts that students completed as an administrative part of their ePortfolio submission. The prompts are included in Table 4.3. The second set of data was from individual semi-structured interviews. The questions included in the interviews are included in Table 4.4.

Table 4.3 Reflective Prompts

Reflective Questions
1. Describe how you feel about the process of creating an ePortfolio.
2. What part of the ePortfolio process was most useful in your learning? Explain why.
3. What part of the ePortfolio process was least useful in your learning? Explain why.
4. When you read through your eportfolio, how do you feel about the work you have done?
5. Tell me something else about your experience of working with the portfolio that you think it is important for me to know.

Table 4.4 Semi-Structured Interview Questions

General Academic and Personal Well-Being

- How was your third quarter overall in school?
- What activities did you have outside of academics?
- Do you do most of your homework at home or during Patriot Period? (study hall)

ePortfolio Reflection

- How do you feel about your ePortfolio this quarter?
- How would you describe the process of having an ePortfolio be your central assessment for the class?
- What makes using an ePortfolio different than being graded in a more traditional manner?

Future goals

- Thinking about your ePortfolio, what might you do differently during fourth quarter?
- How would you feel if you found out your college required an ePortfolio for all classes?
- How confident are you that you will be successful in this course moving forward?

The responses to the reflective prompts were collected on a Google form contained in the ePortfolio which the students filled out before submitting their ePortfolio at the end of the quarter. The responses were downloaded as a spreadsheet. Non-participant data was removed from the file. Student identifying information was removed, pseudonyms were applied, and the spreadsheet was uploaded to NVivo 12. The audio files were reidentified with pseudonyms and uploaded to NVivo 12. The interviews were manually transcribed in the NVivo 12 file.

Coding

Coding began with a deductive approach. There were two general approaches: one was to code the written responses and then to code the transcripts of the interviews. The first cycle coding consisted of structural coding using a set of *a priori* codes on the thematic lenses of the research.

The sets of codes for self-efficacy were modeling, mastery experience, use of feedback, and outcome expectancy. The set of codes for self-regulation were engagement in task, planning, motivation, and reflection.

For the interview data, structural coding was initially used to select segments of the interview transcripts that seemed to relate to the research questions and then those segments would be analyzed further. The interviews were semi-structured and the flow of the question and response moved fairly fluidly from one aspect of ePortfolios to another. The responses to questions did not follow the same pathway for every participant.

The second cycle of coding for the interviews used the same set of *a priori* codes as the written responses.

While both sets of data were being coded with the preliminary *a priori* codes, the codebook and samples of the coding overview were shared with two advisors. Each of the advisors had questions about how the codes aligned with the data. I was also not convinced that I had captured the data in the first-round coding. Several options were considered. The first was to remove some of the written responses from the analysis. Question 2 (What part of the ePortfolio process was most useful in your learning? Explain why.) and Question 3 (What part of the ePortfolio process was least useful in your learning? Explain why.) are prescriptive questions which imply a defined aspect of

the ePortfolio that was useful and a defined aspect that was not useful. The point was made that these questions are more about the ePortfolio and not about the experience of the participants. The second suggestions was that I might consider thinking about the data by participant first and then return to analyzing by question and by data set. To test this approach, I separated the written responses for Beth and for Hakim and paired them with the transcripts of the interviews. Reading over the two data sets, I recognized that there was data that seemed important about the student experience but that had not been captured in the first cycle of coding. At that point I realized that it was possible that trying to skim the data to find samples that matched the *a priori* codes was limiting the analysis. I decided that I would set the *a priori* codes aside and move toward a more inductive approach. With Beth and Hakim's data sets, I used descriptive coding with the goal of using their responses to create an overview or narrative about the learner's experience based on their words. This method reflected a narrative inquiry analysis (Bloomberg & Volpe, 2019; Kim, 2015) to create the experience profiles described in the methodology. In this process, the two distinct sources of data were combined to make a single description of the student experience (Kim, 2015). I noticed that a patten of analysis emerged from that process. I produced an experience profile for five of the participants and shared them with my project advisors. From their feedback, I structured the profiles to be formatted into three sections: An overview of engagement, learner experience, and researcher interpretation and analysis. The overview of engagement is included in Table 4.1. In addition, some of the students' direct words were used in the learner experience section as coded data. After the experience profiles were completed, the learner experience sections of the experience profiles were analyzed and additional

codes were produced. The next section presents the themes identified as the result of the data analysis process and how those emerged from the analysis.

Themes

After generating the experience profiles, the new list of codes was defined and a new codebook with descriptions was produced. The list of codes was taken as a whole and compared with data that had been coded under the *a priori* codes in the initial coding attempt. What I noticed was that I had selected similar segments of data both times and in the first case had assigned them to an *a priori* code and in the second had assigned them to a distinct code. There was quite a bit of crossover from the new data that had been coded and grouped and the original selected nodes. I noticed two general themes: one involved the ePortfolio and the other the learner. The first theme was students discussing the process of making the ePortfolio: How they made the portfolio and how they decided on which artifacts to choose, including their planning process. The second theme was students talking about themselves as learners: how they felt about their work, their achievement and themselves as learners. There was a third emergent theme that I had not thought about which was the affective-based theme of academic stress. I initially thought it might be included in the theme of the learner but it seemed to be distinct and students discussed it in isolation of the other two themes.

The coded data was grouped by general focus and categories were assigned to group the data in a more specific manner. After further analysis of the coded data, I determined the original *a priori* codes should serve as sub-themes of the data and the categories would be placed within each of those sub-themes. On that realization, I also determined that the themes should be designated using the lenses of the study as Self-

Regulation and Academic Self-Efficacy. The process of making the portfolio could be interpreted as self-regulation because the data showed that students made statements about being involved in the process of learning and using the skills necessary to engage in that process. The student description of themselves as learners could be interpreted as academic self-efficacy because those items included how the student perceived themselves as a learner and how they perceived their level of success or mastery.

Table 4.5 includes the Self-Efficacy theme, its sub-themes, definitions, categories and examples from participants' voices and Table 4.6 includes the Self-Regulation theme, its sub-themes, definitions, categories, and examples from participants' voices. Table 4.7 provides the theme of Academic Stress and the definition based on the coded data and literature about academic stress (Davis & Compas, 1986; Jones & Hattie, 1991; Pascoe, Heatrick, & Parker, 2020).

Table 4.5 Self-Efficacy Sub-Theme Coding

Sub-Theme	Definition	Categories	Example Learner Statements
Mastery	The perception of having been successful in domain specific tasks and in learning. The student expresses feeling successful or that they feel successful learning physics. They are confident in their learning and are confident that the work in their ePortfolio shows they were successful. The student reports being a successful learner and talks about learning specifically. Student presents their learning in holistic terms and describes how they demonstrated success in multiple ways.	Feeling of good work	I see work that I'm proud of rather than just looking at tests.
		Focus on learning	You can see yourself doing the work and see yourself connecting the ideas and making it look good
		Learning process	It shows the aspect of knowing how to do the equations. I know how to do this and it means I understand.
		Confidence	It reflects on how good I am as a student in physics doing the ePortfolio

Sub-Theme	Definition	Categories	Example Learner Statements
Modeling	Using examples of successful task completion to gauge progress. The use of observation of others or observation of self in order to modify performance. This includes discussions of collaboration and group work. Students report using the example of other students or their own example to facilitate learning. Students describe using the artifacts in their ePortfolio to help them on new tasks and challenging concepts.	Collaboration	Part of that was working in groups and helping to explain stuff to other people. I think a lot of the time I felt like I understood the content well enough to explain it to other people which I feel is a good indicator for me.
		Informs learning	The portfolio gives you one place where you could go to and see if it'll help... it'll help you later on
		Opportunity to show success	One of the assignments I really liked was where you would solve a problem on the board and take a video of it. I think that it shows I can solve a problem and I can prove I understand it.
		Observation	I did like when we did the videos and shared them on canvas, I thought that was interesting. Because again, my way of doing it might be different than someone else's way. I think that's helpful.

Sub-Theme	Definition	Categories	Example Learner Statements
Outcome Expectancy	The expectation of a particular result based on personal effort or activity. Student discussion of expectation of course outcome based on the specific work they have done. The student states that since they have demonstrated the necessary skills they have been successful and their ePortfolio will demonstrate that success. The student has made a personal investment and expresses a responsibility for the assessment or outcome. Through self-assessment the student may identify areas to improve and spend time working on those areas. Learners have some control of which artifacts are included in the ePortfolio to be used for the grade.	Learning means success	I mean you knew the information. You show whether or not you can do it and you get your grade based on how well you try and how well you show an example of it
		Engaged in process	I will do my work in the future because if you don't do any of the labs, you won't have anything to put into your portfolio, therefore you don't have any proof that you learned the standard
		Choose easy path	When I slacked off on a lab you are held accountable and you have to fix it.
		Feeling of control	I do my best on or that show more fully demonstrate my knowledge more than other things,. I definitely choose things that represent my capabilities and knowledge more. I definitely use assignments that demonstrate my knowledge.
Use of Feedback	Getting feedback from multiple sources and using the feedback to adjust behavior. Feedback could be self-generated or externally given by peers or the teacher. The student specifically discusses using feedback given on particular tasks. Self-feedback recognizes that improvements to an artifact or to the general portfolio. Student expresses an understanding for when things are well done and that they will attempt to replicate the efforts. Discusses using the feedback to improve performance.	What worked	I was going back and … I was relearning the content I already learned. The part where I look back at all the work I did and remind myself of what I have had learned
		Self-Correcting	I wish that I had been more proactive and created my portfolio as the quarter went on, but that is something I can fix.
		Self-Assessment	I was not afraid to fail or ask for help and everything doesn't have to be perfect all of the time. You can do like do more to show you know it, if the first thing doesn't work out for you there are always more opportunities and chances to show you learned something
		Areas for Improvement	It again showed me what areas I needed to work on for the rest of the quarter

Table 4.6 Self-Regulation Sub-Theme Coding

Sub-Theme	Definition	Categories	Example Learner Statements
Awareness	Being aware of the processes and behaviors necessary to be successful. The student expressed understanding their role in learning physics. They talked about the actions they took and what they did to make progress. There was discussion of the connections between their work and connections illustrated throughout the content. Students talked about using different methods or that they have included multiple or varied representations of work.	Connectedness	I would say oh I didn't know that (math) also transferred to over here... Just making those different connections that I think are helpful
		Learner focus	Holds me more accountable doing my work and making sure I actually understand what I am doing
		Engagement in task	ePortfolio encourages me to pay attention to what I am doing.
		Learning process	I had to have it in mind as I was writing it. I said ok this is what I have to talk about.
Motivation	Thoughts and feelings behind the reasons for doing the work. The student discussed being motivated to produce work that will reflect well on them, will show what they know, and show what they can do. The student also talked about thinking about prioritizing work that they felt was important or would have a positive result.	Prioritization of work	The knowledge that I will be creating an ePortfolio serves as motivation to do my best work so that it will be high enough quality to include in that quarter's portfolio.
		Enjoyment	Makes me more motivated to work on the topics that I enjoy and love doing.
		Desire to do well	You see yourself doing the work and see yourself connecting the ideas and making it look good.
		Internal/External	I like having hard deadlines and stuff so the ePortfolio is a little hard for me (reducing motivation)

Sub-Theme	Definition	Categories	Example Learner Statements
Planning	Goal setting and creating the structure to accomplish tasks. This included discussion of actively thinking about what experiences will enhance their ePortfolio. Students talked about the organization necessary or have developed in order to be successful creating an ePortfolio. They discussed setting goals for completing or compiling work and how they used the learning standards to make those decisions.	Goal setting	I found that it is easier to be putting things in during the quarter instead of just waiting until the last week.
		Flexibility	It gives you more time to space things out... you can still know maybe I can plan this out where I have to put one or two things in every one or two weeks so I have something in there.
		Revisiting Work	The portfolio is helpful because I can also put something in where it's like I didn't understand this but then in the next lab oh but now I understand it with this lab and I can fix it.
		Use of standards	I add the science practices in. I try to find an assignment for each one. I thought how each activity would meet the seven practices and would add things to the activities to include more standards.
Reflection	Thought or consideration of the aspects and progress of learning. The student used the ePortfolio to think critically about their work and their progress. They discussed making decisions about revising or revisiting assignments based on new experiences. The student talked about how the ePortfolio made them think about their successes and challenges learning physics.	Overview	I got to reflect on like what parts of physics I was using on each lab and which content related to it.
		Comfort in Challenge	I have to explain how it relates to the concepts or how it relates to the stuff we're supposed to be learning in class. So, I really put a lot of work into it.
		Rethink	Going forward I am going to write them in a way that I am going to understand them when I look at them later.
		Arm's Length	I think it is very helpful for some people. I personally prefer getting graded on the work that I do. So the ePortfolio doesn't really work well for me.

Table 4.7 Academic Stress

Sub-Theme	Definition	Category	Example Learner Statements
Academic Stress	The student specifically describes how using the ePortfolio impacts their academic stress or overall stress. This may be linked to direct aspects of the ePortfolio or a specific comparison between this learning experience and another learning experience.	Academic Stress	I like the ePortfolio because it is a less stressful way of dealing with grades. All of my other classes use the regular grading system, and it is extremely stressful throughout the whole quarter. With this class and type of grading system, I can take a deep breath and relax during the class because my stress levels aren't so high.

Addressing Research Questions

This section is dedicated to answering the research questions. The Sub Questions are answered first as distinct aspects of the experience. The coding of the interviews and the written responses are combined with the narratives to accomplish this. The Central question is answered using a combination of the sub-questions and the narrative overview of the student data. Several graphics will be used to highlight aspects of the described experiences.

Central Question (CQ): How do learners in a physics class describe the experience of using an ePortfolio as the major assessment tool of that class?

Sub-Questions (SQ):

- **SQ1:** What aspects of academic self-efficacy do students talk about when relaying their experiences of ePortfolio practice?
- **SQ2:** What self-regulative behaviors do students discuss when talking about their use of the ePortfolio assessment?

SQ1: Analysis

Sub-Question One: SQ1: What aspects of academic self-efficacy do students talk about when relaying their experiences of ePortfolio practice?

Academic self-efficacy is part of social cognitive theory and refers to a content-specific belief by a learner about their ability to be successful in a particular context (Bandura, 1997). For this research the content is physics and the context is an introductory physics class with an ePortfolio as the main assessment. At the outset of this analysis, aspects of academic self-efficacy were considered to be a set of *a priori* codes. Those aspects were modeling, mastery experience, use of feedback, and outcome

expectancy (Bandura, 1997). After reviewing the literature (Bandura, 1997, 2006, 2012; Bong, 2006; Pajares, 1996, 2006; Schunk, 1991, 1994; Schunk & Ertmer, 2000; and Usher, 2009), those codes were defined for the purposes of this research to be:

Modeling: Using information from watching an expert, peer, or self to gain an understanding of how to solve problems or engage in problem-solving.

Mastery: Having the experience of success. Being successful on a particular task or in gaining an understanding of a concept.

Use of Feedback: Getting feedback from several sources including the results of problem-solving activities, group work, or the instructor feedback from submitted assignments.

Outcome Expectancy: An expectation that the behavior and efforts will lead to success. A feeling of self-determination.

After the initial coding it was determined that these *a priori codes* were limiting the analysis and resulted in data being left uncoded so additional coding methods were used. Creating experience profiles assisted in structural coding and *in vivo* coding to encompass more of the available data. Some examples of the *in vivo* coding taken from the experience profiles in APPENDIX B are in the following two sentences. Shania – "Knowledge I will be creating an ePortfolio motivates me to do my best work, so it is good enough to include". Chuck – "You don't have to understand everything… you are graded on what you learn". After several rounds of data analysis and coding, and after the recognition that the data split could be encompassed in the two major themes of academic self-efficacy and self-regulation, it was determined that these provisional *a priori* codes

should actually be considered sub-themes of the two main themes. The definitions of the sub-themes were expanded to encompass the coded data.

The coded data was analyzed under the sub-themes and rearranged to indicate which aspects of academic self-efficacy were present in the statements and writings of the participants. A hierarchy chart, Figure 4.1 was created using NVivo 12 to illustrate the extent to which students made these references.

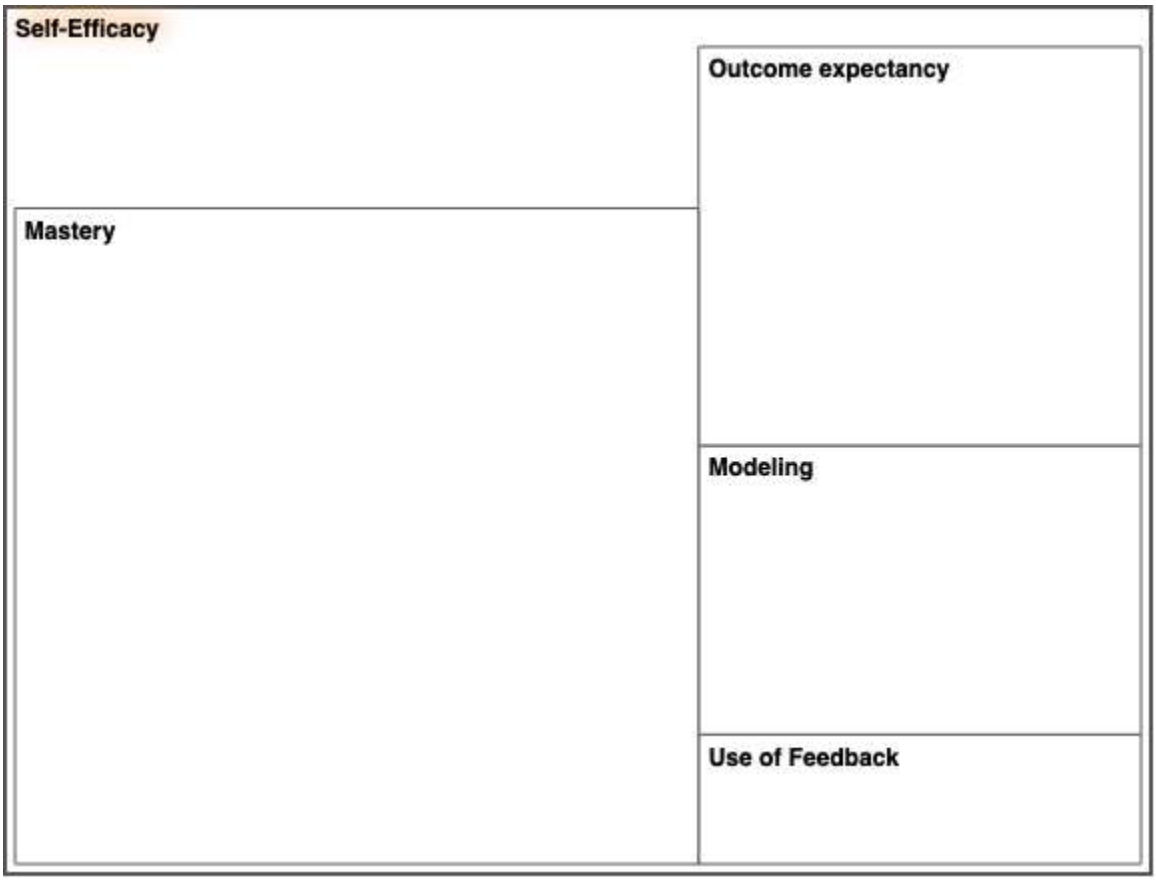

Figure 4.1 Self-Efficacy: Hierarchy of Coding Events

This diagram provides a visual representation of the number of coding references from the participant interviews and written responses. It implies that the data analysis indicated the participants discussed aspects that were identified as related to self-efficacy. The largest references were for mastery and outcome expectancy.

Mastery

The theme of mastery was supported by categories of data that were important which were: a feeling of good work, focus on learning, confidence, and learning progress. All of those categories involved students talking about being successful in the task of learning physics as shown in table 4 and examples of coded data is included below.

Examples supporting the category of '**feeling of good work'** tended to be direct statements about how the students felt about their work and about themselves as learners. For example in the interview with Donny, he stated that using the ePortfolio makes him evaluate his work to be sure it looked good enough to put in the ePortfolio and doing that "Helps you learn and helps you be a better student. Better in physics. A better student". In her written responses, Bria wrote, "I feel that the work I have done this quarter displays my understanding of all the topic we have discussed in class. I have a great understanding".

In the category of '**focus on learning'** students would mention how using the ePortfolio made them focus on learning the material. Often this would be stated in contrast to focusing on a grade or the result of an assessment. In Amanda's written reflections to respond to how ePortfolio informs her work she wrote, "Tests aren't necessary - learning can be shown other ways such as through labs. (the ePortfolio informs work by) The ability to choose work you think will best advance your learning/best displays your learning". This statement actually reflects two areas about focus on learning. The first is that Amanda writes that it will "advance your learning" and the second is that it "displays your learning". This indicates something the learner gets from their work with the ePortfolio, as well as having an opportunity to show their best

work for the grade. Shania gave a long description of how the ePortfolio requires a focus on the learning, “In traditional regular classes that are just graded on assignments…it’s not as much focus on the learning process. This is... This way of doing it makes you think about yourself as a student more as opposed to well I am doing this assignment to get a good grade and just move on. In this, I am going to reflect on what I used. Thinking about how you learn best”.

‘**Learning progress’** captured similar statements as ‘feeling of good work’. Those two categories are related in that students making progress often feel good about their work. In Tony’s interview, he talked about how the ePortfolio encourages moving forward and using the work to show how you have moved forward. “You can kind of put everything that you’ve done and kind of put an explanation of what you learned so you can see the progress. It is nice because the end you can touch it up and do whatever works”.

The category of ‘**confidence**’ was represented with brief and direct statements. There were several such statements made in the written responses. In a section where Beth was writing about how she felt looking over her ePortfolio work and after making another statement, she wrote a brief sentence, “Very Confident”. Shania wrote in response to the same prompt, “I feel confident that I understand the material”, This statement clearly represents a statement referring to mastery.

Outcome Expectancy

Outcome expectancy was supported by categories: feeling of control, engaged in process, choose easy path, and learning means success. These categories involved the

student communicating about how what they were doing would contribute to their future or continued success.

Students used different ways of talking about their experience that indicated they were '**engaged in process**'. Generally this was engaged in the process of learning. Beth wrote in her response, "I feel that the process of creating an ePortfolio is an excellent way of learning because it causes me to rethink and overview the material". This statement indicates that when she is creating the ePortfolio she is involved in thinking about her work and how it represents the facets of physics she has learned. Another example of this is Tony's written response, "I have presented pretty significant work in my portfolio, because all the labs in there and work presented with some key takeaways". He has recognized that his discussions of his work and "takeaways" were important parts of the ePortfolio and of the learning.

For the category of '**learning means success'** the students expressed a belief that they were learning and therefore were successful. Amanda wrote, "I can show my learning on my portfolio" and "I feel like it benefitted me and contributed to my success in physics". Jane said in her interview "It makes me feel better about what I'm doing... I don't know it makes me feel more competent. It makes me feel like I actually got something done in a class". She discussed this in comparison to a previous science class that she had taken where she did not feel successful even though her grade was good. She attributed a stronger feeling of success in physics to a sense that she had a record of the concepts she had learned.

Interestingly, the negative category of 'choose easy path' had been expressed by a small number of students in different ways. This aspect was expected to lead to negative

outcomes. Only one of the students (Karen) communicated an expectation of a negative outcome. Karen stated during her interview that she thought she would have a negative outcome because she "was always choosing the easy path". An example of a student expressing '**choosing the easy path'** was a risk but not indicating an expectation of a bad outcome was during Chuck's interview. He stated, "I realized what I did well and the topics that I should try more on. Because last quarter I did a lot of other stuff but I didn't do many math ones". In this part of the interview, he was talking about the fact that by reading his ePortfolio, he could see that he had not challenged himself to do the difficult work and viewed the ePortfolio as an opportunity to make a change to that instead of having it result in a bad outcome. An additional example of this was Shania making the point in her interview that the ePortfolio gives you the opportunity to make corrections to avoid a bad outcome, "If I had slacked off on a lab and you are held responsible and I have to fix it".

Several students highlighted the category of '**feeling of control'**. Tina had a strong statement about having control over what learning she showed in the ePortfolio in her interview. "I put in the assignments I feel like I do my best on or that show more fully demonstrate my knowledge more than other things. I definitely choose things that represent my capabilities and knowledge more. I definitely use assignments that demonstrate my knowledge more". Another good example is from Jerome's interview, "I'm not the fastest learner in the world. I think I am average at picking stuff up. In other classes similar to science you know I always find myself that the unit ends before I'm able to really nail a concept...like math or something…like we will be studying trigonometry… right when it is just starting to click with me we will move on to

sequences. And through the ePortfolio I am able to take my time and learn at a good pace". A student can have a feeling of mastery in a context where they know what factors will result in their ability to be successful which contributes to academic self-efficacy. (Bandura, 1997).

Use of Feedback

The sub-themes of '**use of feedback'** and '**modeling**' each contained coded items that were important to consider. They were not the main focus of the way the students talked about their experience. The categories of 'use of feedback' were self-correcting, areas for improvement, what worked, and self-assessment.

Chuck stated in his written response an example of '**self-correcting**', "I should have stayed on task more at the beginning of this quarter because that would have allowed me to understand certain things like the math parts better. I will continue to work and I will stay on task more". He also mentioned the same self-correction in his interview that he was working on staying on task. One point to mention is that it was a self-correction because no instructor feedback about time on task had been given or implied.

Supporting the category of '**areas for improvement**', Amanda commented in her written response, "I was rather thorough in what I did; I do think I could have done a greater quantity of work but I did enough to learn the material". Karen stated in her interview, "If we were required to have more things in the portfolio than just the four that embody the seven science principles then I would be more inclined to do all of the labs and stuff". Karen's statement reflected a belief that if there were changes made to the structure of the ePortfolio (a more rigorous minimal requirement) it would result in her being encouraged to work more consistently.

The category of '**what worked**' was an acknowledgement that feedback indicated the student was successful and that continuing with those behaviors or performances would lead to continued success. Bria stated in her interview, "I look back at my previous quarter portfolios just to see how I structured them and see what examples I used and try to relate that to how I build my portfolio just to develop some consistency". This expression of using the ePortfolio as a guide to help structure the learning was an example of a student relying on feedback to understand what had been successful.

In this ePortfolio process, all of the work was essentially '**self-assessed**' in that students reviewed and corrected their work and submitted artifacts that they had assessed as demonstrating progress in the science practices. Tina wrote in her reflective responses, "It shows me what areas I need to work on and what areas I have demonstrated full knowledge in". She gave another example of self-assessment as part of her experience in her interview, "I put in the assignments I feel I do my best on or that show or more fully demonstrate my knowledge more than other things. I definitely choose things that represent my capabilities and knowledge more".

Modeling

The final sub-theme of modeling had categories of collaboration, informs learning, opportunity to show success, and observation. This sub-theme had a good portion of the coding references. Not all students engaged in as much collaboration as others and not all of the students highlighted this as part of their experiences. Those who did addressed it more than once in their interviews and written reflections.

Most of the students engaged in '**collaboration**' at some level with others in the class. Several students expressed that this was an important part of the ePortfolio process.

Erin gave several fairly long statements about collaborating and working with others in physics in her interview. These three statements were in answer to three separate questions.

> If I remember about it and remember what I was doing, I might ask one of my group members because sometimes we send each other the data and we try to make sure that we all have the work that we did. I would probably check with them.
>
> I feel like most people work together a lot, because labs give you the option to say I worked with these people and the work is in their notebook. I still like to have the work, so we share so I can see what we did.
>
> I think it is (collaboration) important for learning. It definitely helps me learn things better.

There were negative indications about collaboration as well. Some students relied on others to collect data or to submit assignments which meant they did not have certain items to include in their ePortfolios. Pete expressed this idea in his interview, "I understand the concept and did all of the work with my peers, but the work that I submitted I have only put in a sentences so I didn't put in the whole explanation, but I did help get to the solution". In this he was explaining that he wrote about the experience even though he did not have all of the data and graphs included.

The second category of '**informs learning'** was exemplified by students discussion how they used examples from class or from their ePortfolio to help them understand how to move forward. Tony talked in his interview about using his ePortfolio from previous quarters to help him with learning new tasks, "The portfolio gives you one

place where you know it's not too long you could go to and see if it'll help... it'll help you later on". In a similar statement in her interview, Jane said "I have the explanations even if they're brief. It really relates it back and it forces me to like think did this actually hit it (the objectives) and did I actually do anything that (shows the objectives)".

'**Opportunity to show success**' for some students involves them demonstrating either by actions or on video their ability to successfully solve problems. Several students used their own videos in their ePortfolios and spoke about that in their interviews. Erin stated in her interview, "One of the assignments I really liked was where you would solve a problem on the board and take a video of it. Because I think that shows like ok I can solve a problem I can prove I understand it". Tina had a similar statement about using video in her interview, " I did problem solving this quarter and the problem solving I did last quarter where we had to show a video of it, I feel like that was helpful because I think that most kids realize by showing a video of themselves doing it, they can't cheat". In this statement, she may not have meant "cheat" in the traditional sense but instead by making a video of yourself actively solving the problem you actually have to do it and describe the solution and cannot simply copy the group solution. The practice in this course was that in a group, each person takes a turn demonstrating solving a question. They can get help from the group members but they must be at a board writing the procedure and repeating the discussion of the solution. For the ePortfolio, some students included this video evidence.

Similar to the above category, '**observing others**' could be watching other members in person or on video. The first part of Tina's statement above from the interview addressed this category when she talks about the helpfulness of having

someone else to observe or discuss. “I think that doing it (problem solving) with her definitely helped me understand it more. Because I feel like having her with me and walking through the steps together and us bouncing ideas off each other helped me get to the solution a lot quicker than if I did it myself”. Bria had a similar statement about the use of video, “The videotaping is helpful. I worked with Jane. We would look at each other’s videos and then looking at the solution and then see how our solutions compared”.

Summary of SQ1

The analysis of the coded data indicated that in response to SQ1, students talked about multiple aspects that could be associated with Self-Efficacy. Those aspects were categorized and were assigned to categories that represented the sub-themes of self-efficacy that were established as related or indicative of the academic self-efficacy of learners. The aspects of self-efficacy that students discussed were generally from the embedded features of the ePortfolio. The intent of using an ePortfolio as an assessment is to shift the focus and control of the assessment to the learner. The way in which participants described their experiences indicated a varied level of involvement in the aspects of academic self-efficacy.

The themes that seemed to be the most important to all students were mastery and outcome expectancy. Those themes were present in both the written reflections and semi-structured interviews of all students.

The understanding of the student experience gained from the analysis of the data for SQ1 can be arranged into positive and negative aspects of the experience. These positive and negative aspects have the potential of indicating negative and positive

influences on self-efficacy. The big picture analysis of SQ1 is that students generally gave positive indications about self-efficacy. The students made statements that described an experience that was supportive of a mastery experience which would tend to result in gains in academic self-efficacy (Bandura, 1997, Pajares, 1996). The students felt good about their learning and they felt good about themselves as learners. Also important for a science class was the focus on collaboration.

The negative indicators about self-efficacy were that some students expressed that the ePortfolio highlighted their shortcomings. Karen, in particular, gave indications that her self-efficacy had not been enhanced by the ePortfolio experience. Several students talked about the fact that they felt like they should have done more work or that the system did not require them to complete tasks. Regarding collaboration, negative statements occurred in statements about lab partners having all of the data and the student only having the conclusion to submit in their ePortfolio.

SQ2: Analysis

SQ2: What self-regulative behaviors do students discuss when talking about their use of the ePortfolio assessment?

Self-regulation in an academic setting refers to an individual having the ability to enact learning behaviors that would reasonably lead the individual to success in a learning environment (Zimmerman, 1990). For this study, references to self-regulation included discussions of the process of creating the ePortfolio and the process of completing learning activities in physics. At the beginning of the analysis the set of *a priori* codes for self-regulations were given as: engagement in task, planning, motivation, and reflection. During the first cycle coding an additional code emerged to account for

data that seemed to fall under self-regulation but not under one of the original codes. That code was given the label of '**awareness'.** After this code was defined I determined that **engagement in task** should be included under the code of awareness. After the first round of coding the provisional codes were found to be too restrictive and were set aside for subsequent coding After reviewing the literature (Bandura, 1997 2012; Schunk, 1994; Schunk & Ertmer, 2000; Usher & Pajares, 2008a; Zimmerman, 1990; Zimmerman et al., 1996; Zimmerman & Martinez-Pons, 1990), the codes were defined for the purposes of this research to be:

Engagement in task: Actively worked on learning activities and selecting learning activities for the ePortfolio.

Planning: Using the science standards to plan activities or time spent on activities.

Motivation: The desire to complete work and to engage in activities.

Reflection: Engaging in thoughtful analysis of work performed and strengths and weaknesses.

Awareness: Understanding how concepts fit together and how to apply standards to artifacts.

As with the codes for academic self-efficacy, these provisional codes were reestablished as sub-themes for analyzing the data. This action was taken when subsequent cycles of codes resulted in groupings that seemed to reflect back to these original definitions. The definitions were expanded to encompass the definitions of categories that were generated in the analysis of the coded data. NVivo 12 was used to

create a hierarchy chart, Figure 4.2, showing the prevalence of coding events that were categorized with the sub-themes contained within the theme of self-regulation.

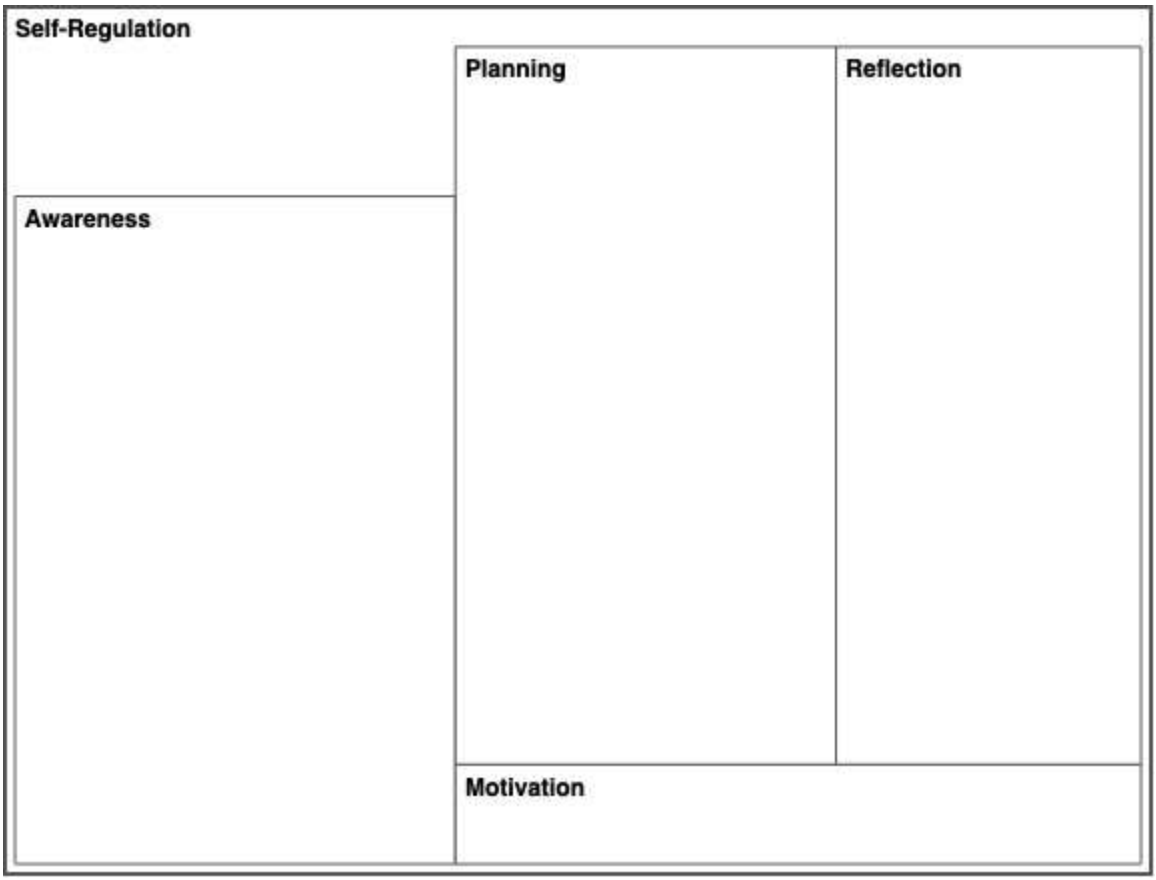

Figure 4.2 Self-Regulation Hierarchy of Coding Events

This diagram provides a visual representation of the number of coding references from the participant interviews and written responses. It implies that the analysis indicates that learners discussed the aspects of self-regulation defined in the study. The sub-theme of awareness that was generated during the data analysis was one of the three most prevalent in the student discussions of their experience. Awareness included engagement in task which was originally a distinct theme. The reason for the change was that awareness was determined to be a linking theme between learner behaviors and learning behaviors. An example of an interview statement that presented a learner

behavior was Jane's statement, "It makes me try to pay attention to the things we are supposed to be learning" which indicates the understanding that being engaged is a necessary component of being successful in this context. The learner behavior of engagement in task is essential for a self-regulated learner (Zimmerman, 1990). It includes self-moderation and working cooperatively with others to achieve success in the class (Zimmerman, Bonner, & Kovach,1996). Tina stated in her interview "I would look and say ok I think I have shown I fully demonstrate this concept so I'll focus on this area or on this concept more". This is an example of a learning behavior. The sub-theme of awareness consisted of the categories engagement in task, connectedness, learner focused, learning process.

Awareness

'Engagement in task' included task awareness which is a central feature of self-regulated learners (Zimmerman, 1990). Hakim gave an example of task awareness in his interview when he was discussing how he decides what artifacts to use in his ePortfolio,

> I make decisions by seeing how confident I am finishing the work how it shows I learn physics... I think about what shows the physics... and what work affected me in a good way. Yes, when I am doing the labs will that go in to my ePortfolio I think how confident I am doing these labs how are they helping me learn physics.

In this statement Hakim is indicating an awareness for how the tasks represent his progress or represent his learning.

'**Connectedness**' refers to a learning behavior of thinking about how aspects of the curriculum fit together and how one skill might apply to several concepts. This is illustrated by Bria's statement from the interview shows this connection, "I would say oh

I didn't know that math transferred to over here... Just making those different connections that I think are helpful".

The category of '**learner focused'** data in the task of making an ePortfolio shows that the learner understood themselves as the subject of the ePortfolio in a sense. For example, Pete stated in his interview, "I did think how I was going to do my work. I thought, you know, if I was able to do an assignment early on and I really understood it, then I could work on the other aspects". Here he was indicating that the tasks he worked on were dictated by the tasks he had already entered as artifacts in his ePortfolio.

An extension of that category is awareness of the '**learning process'**. This would be a recognition of the learning tasks and the use of the ePortfolio combined to inform the learning. Again, Pete stated in his interview, "It kind of shows like how the process of doing it is like work by itself". Hakim wrote in his reflective responses, "Putting the labs and explaining them makes learning physics so much easier". This is an indication of his recognition that the explanation of the artifacts and submission in the ePortfolio was part of the learning process.

Reflection

Reflection was a central aspect of the experience. The categories for reflection included comfort in challenge, arms-length, rethink, and overview. One of the largest areas of coding was for '**comfort in challenge'**. This category was generated from the data and represented coding references of how students expressed thinking about their success and challenges. Students reported using the ePortfolio to think about areas they needed to work on. An example of this is Erin's statement, "I think I can show you I have any gaps in my understanding like if I'm putting the portfolio together and I can't find

something that covers a concept... then I think oh maybe I should take a look back at this". They were comfortable not doing well on a task and then thinking about how they might move forward. Jerome said, "I remember we were way off at first and then we kind of reeled it back and had to recalculate it" while talking about an assessment task (lab test) that he and his group had done incorrectly and decided to revise, correct, and repeat.

The second category was '**arm's length'**. This category was created for just a few coding references that were clearly a type of reflection but a reflection that did not seem to align with the student's experience or perception of the ePortfolio. In particular, Karen was not very comfortable with her ePortfolio experience and is a divergent case in this analysis. However, when asked her opinion about the ePortfolio in the interview she stated, "I respect ePortfolio grading because it does allow you to do the self-evaluation that you don't get with other types of grading". This is an example of an arm's length reflection where she sees a positive but not for her. Another example was Amanda's interview when she talked about using the video evidence, "For me, they weren't that helpful but I can see how they would be helpful for someone else".

The last two categories of reflection are '**rethink**' and '**overview**' which are more directly related to when a student directly states reflecting on their work. A case where the reflection was 'rethinking' was Chuck's written response, "It is helpful for seeing the work I have done and what I could improve on for next time". A second case of '**rethink**' was Shania's written response, "Reflecting on my work and considering what improvements I should make". Both of those examples are showing a student directly thinking about what they did and what they should do to improve the outcome. A reflection that is an '**overview**' would be one where a student thinks more broadly about

their work or the physics. As an example, Beth stated in her written response “The most useful part of creating the ePortfolio was going back and it was like I was relearning the content I already learned. The part where I look back at all the work I did and reminding myself of what I have had learned”. In her interview, Beth gave a similar statement, “It allowed me to see what I worked on. And like all my efforts that I made throughout the quarter and rather than just like completing it and then never looking back at it, it allows me to look back at it and refresh myself of what I learned”.

Planning

Planning included the categories of revisiting work, use of standards, flexibility and goal setting. The category of revisiting work is distinct from reflection and rethinking. ‘**Revisiting work’** was part of the planning process. The student often would indicate they had reflected on their challenges and then revisiting the work was part of the planning process to understand how to arrive at success. The second part of Jerome’s comment from earlier is a good example of this, “It was kinds of like a myth busters episode where you like you know we work through the problem and realized where we went wrong and then we said ok let’s go back but let’s get it right this time”. Another example is in Tony’s written reflection, “ePortfolio lets me go back to it, pretty easily when I need to access something or look back on something I may be confused about and help me improve in certain areas and organizes what I've learned”.

‘**Flexibility**’ was part of planning in that students discussed flexibility when they talked about how they decided which learning activities to include and what to focus on about those activities. Amanda discussed flexibility when she stated in her written responses, “I really like using the portfolio, especially in a science class because there are

many ways other than tests or quizzes to show you've mastered something. I think it helps a lot with learning physics and gives a greater flexibility in learning (which I found especially helpful during online learning)". A negative statement about '**flexibility**' came from Austin's interview. The ePortfolio had a flexible timeline which resulted in some students procrastinating putting assignments in the ePortfolio as artifacts. Austin commented, "I do work on it during the quarter. I put in one and then two weeks later I put in another. I feel like there is not too strict of a limit. Maybe like certain due dates or reminders to make sure you have at least one artifact by week three would be helpful".

Several students also indicated that using the ePortfolio either encouraged organization or required organization and that one of the things that helped organizing and planning was the '**use of the standards'**. Jane wrote in her written response, "The separation of the seven practices because it forced me to categorize the class skills and understand what exactly I was doing in that context". Donny stated in his interview, "Organization is probably the main thing. Makes you feel organized and get organized…helps you stay organized and have a final plan at the end of the year so when you are doing your work it is not without a purpose, you still have your portfolio and you want it to work well". In his statements he was talking about what the science practices did for his organization.

Finally, the category of '**goal setting**' was addressed. In her interview, Amanda talked about the process of setting and achieving goals which would lead to setting the next goal. "Now that I've done this lab I can achieve this goal to analyze data. Sometimes (in school) you don't understand why you are doing things. In this way you can apply it to a greater process". Tina stated in her interview, "So it's less stressful and easier for me to

like set goals like okay I need to get this done and then I will put it in when I am done. And then after that I should do that, it is definitely easier to put things in as I go, and definitely easier if I set goals…like by using the ePortfolio".

Motivation

The final theme of self-regulation was motivation which had the categories of prioritization of work, desire to do well, internal/external, and enjoyment. While students might generally have been motivated, it was not widely included in their discussions. This was one area of self-regulation where there was a negative indication. Karen had indicated that the lack of hard deadlines or direct connection to an assessment reduced her '**motivation**'. This is an example of data that fell in the internal/external category. "I like having hard deadlines and stuff so the ePortfolio is a little hard for me. I started out the quarter really determined to do everything, get everything in and unfortunately that didn't end up happening as much as I wanted it to. I wasn't as focused as I probably should have been but I tried". However, she also recognized the lack of motivation as an area of self-regulation that she needed to work on.

I've been trying really, really hard to get better about doing all of the assignments on time, well not on time, because, but doing all of them the day we are supposed to be done in class. I've been trying harder to do that and I think if we went into fourth quarter still doing this that would be better. I would get better at not procrastinating and doing stuff when it is supposed to be done.

She was expressing having internal motivation that was not large enough to result in progress and that having additional external motivation might improve the experience.

Karen's comment could also fall under '**prioritization of work'** since she later stated, "My brain is like ok this isn't important do other stuff...and then shove that till later... but it keeps getting shoved till later and it keeps getting shoved till later there's always something else". Another example of prioritization of work increasing motivation was Bria's statement about needing to be self-motivated. "Since I have physics first period it takes me a little while to get the balls rolling... and start going at it. The majority of the time I feel like I do get started right away".

'**Desire to do well'** is a separate construct from 'internal/external', this statement went beyond the accomplishing of a grade, but 'doing well' as a function of learning. An example of '**desire to do well**' was Donny's statement in his interview "I think it helps kids learn a lot more instead of just being in a class where you are like trying to get a grade in this we are trying to learn physics and get knowledge about physics instead of a grade".

Summary of SQ2

The analysis of the coded data indicated that in response to SQ2, students talked about multiple aspects that could be associated with Self-Regulation. The aspects that students discussed were coded and grouped and assigned to categories that represented the sub-themes of self-regulation that were established as related to or indicative of self-regulation. The aspects of self-regulation that were identified were generally associated with embedded features of the ePortfolio or from the standard practice of producing an ePortfolio. The intent of using an ePortfolio is to provide a more learner-centered assessment to support a learner-centered learning environment. That simple fact would require students to practice features of self-regulation like reflection. Being a self-

regulated learner has as self-efficacy of its own and being successful at practicing self-regulative behaviors requires practicing those behaviors.

The themes in SQ 2 that could be identified as important to students were awareness, reflection, and planning. Those aspects also seemed to be common throughout the student descriptions.

In a similar result from SQ1, student discussions that were indicative of self-regulation included both negative and positive features of the experience. The negative aspects of self-regulation might point to an experience that was not supportive of the learning and might have resulted in fewer learning gains. For SQ2, the negative aspects will be treated first. The most prevalent negative aspect discussed by students was procrastination. Karen gave very thorough statements about how she felt the ePortfolio had actually increased her tendency to procrastinate. The fact that assignments were not required to be added and were not required by a certain date created a negative motivator for her to finish her work. Her experience would likely be the experience of other students who have a tendency to procrastinate. Karen and others also reported a lack of motivation to finish work and to choose to work on difficult problems. Another negative aspect was that students were reflective about their work but their reflections were not always valuable as assessments of learning or progress.

One of the aspects which resulted in negative statements also resulted in positive statements. The flexibility of the ePortfolio assessment was a central feature. Students who talked about flexibility attributed it to their level of success. This aspect was presented as giving the learner the ability to choose the tasks that would result in the highest level of learning. The flexibility of which assignments to add and how to compile

the ePortfolio gave students a feeling of control over their learning and of their assessment (grade). Students who used the standards (Seven Science Practices) discussed that aspect as one that helped them understand how their learning all fit together. Use of the standards helped students be reflective about their progress as well. Students who relied on the standards to reflect seemed to produce better reflections.

Analysis of Central Question:

To address the central question, first the data was considered as a whole set then the results of the data analysis from the two sub-questions was integrated to make single statement about the ePortfolio experience of the participants.

To consider the data as a whole, the data was used to create an understanding of the experience of using the ePortfolio that was described by the students. The ePortfolio is a learner-centered assessment. As a result, each participant created a novel ePortfolio and the individual experiences were distinct. In the analysis of the data, I first described these experiences in a brief experience profile for each participant. It seemed important to recognize aspects of the individual student experience in order to be able to include concerns or negative statements of individual students that might be obscured by the larger set of data. To begin the analysis the central portion of the student experience profile was used. This part of the experience profile was created by synthesizing and summarizing the interviews and the written responses. The full table containing the experience profiles is in APPENDIX B. A sample of two students is below in table 4.7.

Table 4.8 Sample of Experience Profiles from APPENDIX B

Pseudonym	Narrative and Analysis of Experience Profile
Hakim	Hakim expressed a feeling of control and that he appreciated having choice in what he would present as evidence of learning. He discussed feeling successful and that seeing his work in the ePortfolio makes him feel good because he can see that he has done good work. The ePortfolio process made learning physics easier for him. He also stated that using the ePortfolio makes him feel like he is moving forward in the class and it makes it easy to see his progress. His expressions of confidence and feeling good about his work are a little bit in contrast to his behavior of focusing on the procedural points during the interview. This behavior made it seem like he might not be as confident as he states. In his written reflections he also expressed a concern that he might not always know if everything is "right" when he puts it in the ePortfolio. He did express a feeling of progress overall. In his written responses he wrote, "Having the choice of what to put and not to put made me feel much better and made me do better work"
Beth	Beth views the ePortfolio as a valuable learning tool. She expresses a feeling of pride and confidence in the artifacts she includes and experiences that the ePortfolio highlights. She focused on pride and confidence in both her responses to the written reflective prompts and in the interview. She used the ePortfolio as a way of looking back at her work and thinking about what she had learned in the class and how each artifact shows something about her progress. She also discussed looking back at work and making corrections when she recognized something wasn't quite right. Beth also discussed that using the ePortfolio made her feel comfortable addressing areas that she recognized as weaknesses and to keep working to make improvements. She mentioned in both the interview and written responses a lowered level of stress in the class compared to other classes that she attributed to the use of ePortfolio as opposed to traditional grading. She contrasted the two as learning as opposed to getting ready for a quiz. She mentioned learning and making progress. The ePortfolio made her feel engaged in the process of learning physics. She expressed a feeling of power and control over what was included and what would be evaluated. Confident that she has been successful in physics as evidenced by the artifacts and her written reflections about her work. Beth expressed that the ePortfolio was a benefit to her learning. Both her interview and her written responses indicated that she felt successful in the class and in using an ePortfolio. She is one of the students who had not used an ePortfolio in the yet expressed being confident and comfortable. A statement in her interview that summarized this was "Tests tell a day the ePortfolio tells my work".

When students were asked about their experience, they generally talked about it in positive terms by focusing on their experience using the ePortfolio to display their work. Learners focus on how using the ePortfolio contributed to their understanding and learning of the content and in understanding about themselves as learners. For example, Donny stated in his interview "I think it helps kids learn a lot more instead of just being in a class where you are like trying to get a grade. In this, we are trying to learn physics and get knowledge about physics instead of a grade". A second example of this was Erin's statement in her interview "It shows me that I've learned that I am capable of knowing what I have learned and what I haven't learned which is something I like".

The ePortfolio is also viewed as part of the work that is done for the course and that it involves thinking about the objectives and the work they have done to meet the objectives. This was an area that Jane focused on with her statements during her interview of "I like the way you can set it up and there's a main criteria so I can look at what I need to know". and "I have to think about whether my work fits what you want us to do and I have to look at the concepts and see if I understand them".

Combination of Sub-Questions

The analysis of the sub-questions also provides aspects of understanding the experience of the learners using an ePortfolio. The descriptions of the experience of the participants included aspects of Self-Efficacy and Self-Regulation as seen in the earlier analysis. For the purposes of answering the central question the SQ's can be summarized into five general points. Those five points are feeling of self and of the work, feeling of power and control, awareness, reflection, and planning. These were taken from the main foci of the SQ's. For SQ 1 the focus on Self-Efficacy centered around the first two points,

how the students felt about themselves and their work (mastery) and that students felt in control over their success (outcome expectancy). The next three points were taken from the direct themes of Self-Regulation summarized by SQ2.

The first point is that students discussed aspects of mastery they were referring to their feelings of having been successful. Examples given earlier for this were Donny stating in his interview, “Helps you learn and helps you be a better student. Better in physics. A better student”. A second example was Shania’s statement “This way of doing it makes you think about yourself as a student”. In these cases the students were focusing on how they felt about themselves as learners and what they thought about their work in physics.

Outcome expectancy tended to center on how students perceived their level of control over their evaluation and learning process. Tina stated, “I put in the assignments I feel like I do my best on or that show more fully demonstrate my knowledge more than other things”. Participants expressed feeling like they had the ability to make choices about what aspects to focus on and what aspects to include in their ePortfolio.

Aspects of self-regulation can be drawn as more direct points. Awareness was a strong point of the described experiences. The discussions included aspects that the students were aware of what they needed to learn, what activities and tasks would provide evidence of that learning, and the self-awareness of their strengths and weaknesses. An example of this given earlier was Bria’s statement in her interview. “I would say oh I didn't know that math transferred to over here... Just making those different connections that I think are helpful”. Where she was talking about the ePortfolio helping her to see connections between the data.

A fourth point which could be drawn from self-efficacy and self-regulation was reflection. This direct theme had data which was included in both sub-questions. The statement of Beth, "The most useful part of creating the ePortfolio was going back and it was like I was relearning the content I already learned. The part where I look back at all the work I did and reminding myself of what I have had learned", had aspects of being reflective and of thinking about level of mastery of the physics.

The final point was planning which was also part of the analysis of SQ2. The descriptions of the experience of many of the participants included statements about how they made decisions about which work to do. Tina stated in her interview, "So it's less stressful and easier for me to like set goals like okay I need to get this done and then I will put it in when I am done. And then after that I should do that, it is definitely easier to put things in as I go, and definitely easier if I set goals".

Negative Aspects

Negative aspects of the experience needed to be considered to add trustworthiness to the study (Shenton, 2004). The negative aspects included procrastination, negative self-reflection, lower accountability and need for more direction.

For example, Amanda in her written response indicated "It seems easy to procrastinate assignments/ not keep up with work while using the portfolio. It becomes easier to procrastinate work when using the ePortfolio". Erin, also in her written responses, stated "I'm bad at working on it throughout the quarter so I always have to do it at the end when I've forgotten which assignments I'm most proud of". While Pete in his interview expressed "I did a lot of the stuff with my group and for a lot of it I don't have the write up. I don't really like LabArchives... how it makes you do the work. You have

to drag a text box every time you put it in. I understand the concept and did all of the work with my peers, but the work that I submitted I have only put in a sentence or two so I didn't put in the whole explanation".

Several times procrastination was mentioned or inferred from statements the learner made about challenges or their engagement with the process. Jane gave an example of how she was developing a different work ethic for setting goals to keep herself current with her ePortfolio. "I have been trying to do that (set goals). First quarter I didn't know exactly what I was doing with it (the ePortfolio). I think I started maybe at the end of it. Second quarter I started near the beginning. This quarter I definitely started setting goals like the first thing I did starting the quarter and I am pretty sure I did use that and made an outline".

In particular, in Karen's interview she discussed that the lowered accountability contributed to her always having something more pressing to complete. She stated,

> So even though I know I need to get it done, when it isn't a thing that I have to have it done by a specific day and a specific time. My brain is like ok this isn't important do other stuff... and then shove that till later... but it keeps getting shoved till later and it keeps getting shoved till later there's always something else.

She also viewed the minimum requirements of the ePortfolio as contributing to a lack of motivation and encouragement to do the minimum, "I do wish that we were required to put more things in the ePortfolio rather than just four per module because um.. that kind of gives me a little bit of the mentality that I have to do four things and then after that I can be a little more lax".

An interesting point is that Austin was the only participant for whom procrastination resulted in a reduction in grade due to a school system deadline. Generally, the flexibility of the ePortfolio allows students to partially complete work and return to it at a later time or even wait until they are putting it in their ePortfolio for the quarterly assessment. If a student delays submitting the ePortfolio there is a chance the grade will be based on completed work instead of their ePortfolio artifacts and reflections. This is a directive by the administration at the research site. Austin fell into this category. His work was delayed and his ePortfolio was delayed which resulted in a lowered grade outcome. When he was asked during the interview how he felt about his grade he said, "I mean I feel like it's fine, because you basically have all quarter to do it. I do work on it during the quarter I put in one and then two weeks later I put in another. I feel like there is not too strict of a limit". Even though it was clear procrastination had resulted in a bad outcome, he did not discuss procrastination as a drawback of working with the ePortfolio process. He did mention in the interview that assistance setting up goals might help his procrastination. He viewed the flexible timeline of the ePortfolio as a positive element because it had allowed for a delayed submission to still be considered successful. This is highlighted in his interview statement "I remember what I did during the whole quarter. I actually went through and look at some of the questions to make sure that they were good and it wasn't just some b.s. work... So at least I had extra time to do that".

A second issue that appeared several times was negative self-reflection. Most of the students viewed this as a positive aspect of the ePortfolio since they could think critically about their work and even include artifacts that illustrated shortcomings without

considering the body of work as lacking in achievement or as being unsuccessful. However, two examples that are contrary to this are Karen and Samantha. When Karen was asked what the ePortfolio made her think about herself as a learner she said, "It makes me think about my shortcomings". Samantha spoke very positively about her ePortfolio experience, but she reported that the experience might make her less confident taking a future physics class because of the lack of focus on traditional assessments. She said in her interview "I think (I feel) a little less confident because this is more relaxed, not about tests".

Finally, as a group, the participants spoke positively about the flexibility and the level of learner-control over how the ePortfolio was completed. This was a major positive theme of the ePortfolio assessment. There was also some discussion during interviews of a need for more direction or structure. For some students, the openness posed a roadblock. For example, Hakim's interview consisted of a large amount of discussion about what was needed and to gain reassurance that his ePortfolio met the expectations, "Just like the same as first and second quarter. I just have a question. My portfolio remember when I did the slides and thoughts? How do you want me to submit it this time? Can I make the slides and then submit it in to the (lab archives)..the same as before?" Karen, again, viewed the openness as an invitation to do the minimum amount of work, "When I am doing my portfolio I realize how much I haven't done".

Academic Stress

An additional part of the experience that emerged as a theme was that of Academic Stress. Initially it seemed like that might be a theme of Self-Efficacy but the references made were distinctly related to academic stress and given separately from the

discussion of the learners or the process of learning. Although some of the factors associated with stress were also associated with themes of self-efficacy and self-regulation, a clear distinction could be drawn. Students both directly said that the ePortfolio reduced stress and implied it by saying they were comfortable getting wrong answers and did not worry that being wrong or having difficulty would lead to a negative impact on their grade. A good example of this is from Tina's interview. More than half of her interview was about the negative impact of stress and how the ePortfolio helped relieve that stress. A brief part of that statement was

> I think that having the ePortfolio is definitely... I just don't understand what the added stress is for. I don't understand why it has to be so stressful. So I think having the ePortfolio, it makes school what it should be. I mean you knew the information. You show whether or not you can do it and you get your grade based on how well you try and how well you show an example of it.

There were several other direct statements about stress that students made both in the written responses and in the interviews. Erin stated in her interview, "A lot less stress for a lot of people and putting the focus on the learning instead of grades". Samantha wrote in her responses, "I like the ePortfolio because it is a less stressful way of dealing with grades. With this class and type of grading system, I can take a deep breath and relax during the class because my stress levels aren't so high". Tony wrote in his responses, "I really like it because it can take away some extra stress or worries".

Summary of CQ

In the above analysis, it can be seen that there is considerable crossover between the experience in terms of self-efficacy and self-regulation. While those are two separate

concepts, they are closely related and the same sample of data from the experience that reflects an aspect of self-efficacy might also reflect an aspect of self-regulation. For example, it was clear from Karen's interview that her tendency to procrastinate was also having an effect on her self-efficacy. She stated, "I mean it does make me aware of my failings or my shortcomings in regard to the work that I do". She also talked about wanting to do well and just not being motivated by the structure of the ePortfolio "I did get some stuff done, but I, I wasn't as motivated um… I guess yea I wasn't as motivated as I probably should have been but I tried". Other students pointed out this issue as well. The category of 'choose the easy path' in Self-Efficacy resulted in similar evidence as 'motivation' and 'procrastination' in Self-Regulation.

The positive aspects of the ePortfolio experience relating to self-efficacy and self-regulation also had areas of crossover. Generally, the good feelings students talked about in their interviews and written responses were related to their feelings about themselves as learners. They were proud of their work and happy with the outcomes they were seeing in their progress. Seeing the outcomes of their progress was through having the awareness necessary to engage in self-regulated learning. They were aware of what needed to be done and how to engage in the tasks to accomplish them. The experience described by the learners involved quite a bit more focus on areas of self-regulation. As mentioned before, the very structure of the ePortfolio as assessment creates a need for students to engage in self-regulative behaviors. Since there is flexibility, the student has to make the decisions about what artifacts should be included in the ePortfolio. As part of that decision, they need to set goals for learning and then determine how to make meaningful steps toward those goals.

There was an additional theme of Academic Stress that emerged during the analysis of the data. This theme was an important part of the student experience and will be linked to literature in Chapter 5.

One important note about the answer to the central question of the research is that some of the experience might be attributed to the manner in which the ePortfolio was administered in this particular class. Both the negative and positive statements about the experience could be directly a result of instructor behavior. The negative statements and some of the negative outcomes were within instructor influence. A further discussion of this idea is included in Chapter 5.

Summary

This chapter was divided into four sections: participant profiles, data and analysis, coding, and themes. The first section was dedicated to creating an understanding of the participants in the study. That was accomplished by describing the participants, the context of the research, and giving an overview of the manner in which, the participants engaged in the study. This portion also included a description of the researcher as a participant-observer to illustrate the connection between the analysis and the context of the participants.

In the analysis, I illustrated the data that was collected from the student interviews and written responses to reflective prompts. The intent was to help create a description of the experience of learners using an ePortfolio as the major assessment tool in an introductory physics class. That was accomplished by combining a presentation of the data with a synthesis of the student experience. It was valuable to share individual experiences and then to offer a combined summary to represent a holistic description of

the experience of learners. Care was taken to also illustrate and include negative or contrary information and to introduce areas that should be discussed in the trustworthiness of the study.

For the analysis, the data was categorized and assigned to the themes of academic self-efficacy and academic self-regulation. The planned provisional codes for each of the themes were assigned as sub themes. These themes and sub-themes were fully described in the context of the third section of this chapter and are summarized in table 3.1. Each of the sub-themes included specific examples from the analysis and coded data. The central question was addressed as a holistic description of student experiences.

I found that students do include aspects of self-regulation and self-efficacy when talking about their experience using an ePortfolio for the purposes of assessment in an introductory physic class. Specifically, mastery and outcome expectancy were prevalent as aspects of academic self-efficacy while awareness, reflection, and planning were prevalent as aspects of self-regulation. Overall, students talked slightly more about aspects of self-regulation than academic self-efficacy. An additional theme of academic stress was uncovered during the analysis and is discussed in Chapter 5.

CHAPTER 5: DISCUSSIONS OF RESULTS AND CONCLUSIONS

This chapter highlights major findings and provides an overview of the results from this research. The focus of this study was to establish an understanding of the experience of learners creating an ePortfolio for the purpose of receiving a grade in a high school physics course. In Chapter 4, the analysis provided an overall picture of that experience. Learners who were participants in this study described positive and negative aspects of the ePortfolio experience. As the teacher of the class, I am inclined to focus on the positive aspects. This is partly because I have the belief that an ePortfolio is a meaningful and valuable authentic assessment as described by the literature. Another inclination (described in Chapter 4) was that it occurred to me that the negative outcomes from SQ1 were within instructor influence. That recognition is an important part of the student experience and will be a central part of the discussion.

The use of ePortfolios is considered a High Impact Practice (HIP) by the Association of American University and Colleges (AAUC) (Watson et al., 2016) and other research has shown the ePortfolio to be supportive of learning as a learner-based authentic assessment (Buyaraski et al., 2017). The qualitative analysis presented in this study indicates agreement with those findings.

This paper contributes to increased understanding of the experience of a learner using an ePortfolio and makes suggestions about implementing ePortfolio as an assessment practice. Generally the students who participated in this study reported

learning the content, feeling good about their progress and about themselves as learners, and feeling a sense of control over their learning.

The limitations of this study limit the transferability of the findings and this will be addressed later in the chapter. Insight was gained through the research about how to best support students using ePortfolio which is supported by the literature. The primary point is that ePortfolio supports learning based on the described experiences of the participants (Batson et al. 2017). Flexibility of content, purpose, and platform are important features (Scully et al., 2018). Too much flexibility can create uncertainty and lead to procrastination or lack of progress (Rossi et al. 2008). Clear guidelines must be established and the used of standards is important (Rate, 2008; Scully et al., 2018). Finally, students must be supported in working with an ePortfolio including support understanding how to engage in meaningful reflection (Jensen, 2011; Rate, 2008; Slepcevic-Zach & Stock, 2018).

The rest of this chapter is organized in five sections. The first section is a summary of the study which includes a discussion of the problem, the setting and context of the study, the participants, and the research questions. A discussion of findings of each of the research questions and their connections to literature follows. Each of those discussions is followed by a conclusive statement about that particular research question. The third section presents a discussion of the implications for teaching, learning and assessment. The fourth section is a discussion of the limitations and efforts to ensure trustworthiness of the data and analysis. The final section is a discussion of questions raised by this research and suggestions for future research.

Summary of the Study

This study was a basic qualitative study (Merriam, 2009; Merriam & Tisdell, 2015) to establish an understanding of the experience of learners creating an ePortfolio for the purpose of receiving a grade in the course. The experience of the learners was examined using the learner's written responses to reflective prompts and through recordings and transcripts of semi-structured interviews.

The participants were seventeen students enrolled in an introductory physics class where the primary assessment tool was an ePortfolio. The participants were students attending a large (2000+ students) suburban public high school in the Northeastern Region of the United States.

To establish an understanding of the experience of the learners a central question and two sub questions were generated.

Central Question (CQ): How do learners in a physics class describe the experience of using an ePortfolio as the major assessment tool of that class?

Sub-Questions (SQ): These questions were developed to further assist in building the understanding of the experience.

- SQ1: What aspects of academic self-efficacy do students talk about when relaying their experiences of ePortfolio practice?
- SQ2: What self-regulative behaviors do students discuss when talking about their use of the ePortfolio assessment?

The basis for using academic self-efficacy and self-regulation as the focus of the sub questions comes from my experience using Portfolios and ePortfolios over a period of almost 10 years in the classroom. While I did not have direct evidence that students

performed any differently in the course based on the use of an ePortfolio assessment, I observed a difference in the way the students reported feeling about their performance. This lead me to believe that there were other value-added features of ePortfolio assessment.

Discussion of Findings

This section is divided into three sections that mirror the analysis in Chapter 4. The first two sections are a discussion of the two sub-questions and the third is a discussion of the central question.

Sub Question One (SQ1): What aspects of academic self-efficacy do students talk about when relaying their experiences of ePortfolio practice?

In the analysis the coding of the data revealed that students discussed the identified aspects of self-efficacy (mastery, outcome expectancy, modeling, and use of feedback).

Researchers have found that the use of an ePortfolio enhances academic self-efficacy. In particular, the use of ePortfolios has been linked to increases in self-efficacy and professional identity in STEM (Science Technology Engineering Math) courses (Conefrey & Smyth, 2020). Picardo and Sabourin (2017) used self-reporting on a structured survey by students in college science classes that used an ePortfolio. Those students reported that they had increased their readiness for more demanding work and had increased their tolerance to obstacles. Both of those factors are directly related to mastery. Learners who have academic self-efficacy perceive that they have achieved mastery and are confident that they would be successful at future learning in that context (Bandura, 1993,1997; Pajares, 1996, 2006; Schunk, 1996). Learners with high academic

self-efficacy often persist longer at difficult tasks and are not deterred as easily by obstacles to success (Bandura, 1997; Pajares, 2006). Studies by Singer-Freeman and Bastone (2017) and Singer-Freeman, Bastone, and Skrivanek (2014, 2016) found that learners using ePortfolios developed academic identity and future orientation which were defined by the researchers as facets of academic self-efficacy.

The main features of self-efficacy identified in the analysis of the data in the current study were mastery and outcome expectancy. All of the students had data coded under the theme of mastery and most had statements coded under the theme of outcome expectancy. While coding the data I engaged in writing memos to myself about the process. In those memos I noted the fact that it was evident that since the interviews were generally seen as quarter ending events by the students, they tend to talk a lot about how successful they feel they were in learning the physics. Therefore, this particular result was not surprising. The important part of this input are the qualifiers the participants used to discuss their mastery. These qualifying statements are included in some of the coded data and were discussed in Chapter 4. The literature shows that the use of ePortfolios can increase the sense of mastery of learners (Johnston et al., 2006; Theodonsiadou & Konstantinidis, 2015). The study by Johnston et al. (2006) was very similar to the current study because in the Johnston study the ePortfolio was used primarily as an ELN with aspects of ePortfolio practice included. The participants in both studies reported feelings of mastery. Theodonsiadou and Konstantinidis (2015) was focused on elementary school which is a different population than the current study, but their findings about mastery are important to mention. Feelings of mastery was one of their main findings. Those findings

were from the students, teachers, and parents. All three groups expressed that the ePortfolio contributed to a mastery experience.

The same is true for outcome expectancy. The students would express how they thought the things that they had done would lead to success or had led to success in the class. The important features were that students were able to identify reasons for their success. They also communicated that if there was a concept they did not understand they would focus on that in order to improve and be successful. Outcome expectancy is related to an individual feeling of control over the outcome and students expressed control or power as an important feature of their experience with the ePortfolio (Rate, 2008; Yastibas & Yastibas, 2015).

There were not as many coding references for use of feedback as it was not a primary part of the discussion of most of the students. However, it was a prevalent theme as most students had at least one coding reference under this theme. The theme of use of feedback had a large crossover with codes also included in reflection (self-regulation) because both involved different aspects of the same principle. Frequent meaningful feedback has been found to have a significant effect on academic performance (Hattie, 2008; Nichol & Macfarlane-Dick, 2006) and the use of an ePortfolio facilitates giving feedback to learners about their progress (Rate, 2008, Scully et al., 2018). The use of an ePortfolio creates a platform for the ongoing use of feedback and interactive feedback while the learning is taking place. The school in this study has been using ELN's and ePortfolios as a pilot in some science classes. The teachers involved have found that the use of ELN and ePortfolio in science courses allows for continuous feedback since the materials are online and do not need to be collected and returned during the feedback

process. This same result has been noted in other studies of ePortfolio and ELN use in STEM classes (Riley, Hattaway, & Felse, 2017; Johnston et al., 2006). In the current study, the students discussed how they used feedback to make progress in the course and how the ePortfolio both benefitted from feedback and contributed to receiving feedback.

The theme labeled modeling had the fewest coded references. 'Modeling' was the observation of a model performing tasks or being successful at tasks as a way of gaining self-efficacy for performing that task. One of the reasons this was not as prevalent was that not all students included this aspect directly in their ePortfolios. Since ePortfolios have both required and optional elements, the students may have not selected activities where modeling was evident. In addition, since the study was about the aspects of the ePortfolio discussed by the participants, this area may not have been an aspect that students focused on in their written reflections and interviews. There were specific activities where students worked together demonstrating problem solving and made videos of themselves and partners engaged in problem solving. This is an example of peer and self-modeling as described by Schunk, Hansen, and Cox (1987). During the year, students were required to engage in collaborative problem solving. During second quarter, they practiced making videos of themselves and submitting the videos as evidence of the completed assignment. Including the videos was part of the second quarter ePortfolio entry but it was optional for third quarter. Students had the option to include what they thought was most important. Since school ended three weeks before the end of the quarter, some students may not have had access to completing a video for submission. The participants who included videos (Beth, Bria, Chuck, and Tina) talked about that aspect and discussed how using the videos helped them think about alternate

ways of solving physics questions and about how to work through difficult questions. Some students also self-selected video evidence for other aspects of the ePortfolio. One of the participants, Beth, discussed using video evidence to reinforce artifacts of lab work and using it as part of in her reflection to illustrate mastery of a concept.

In the ePortfolio for this physics class, students were encouraged to include video evidence of their work. Video evidence of work and of learning is a feature of ePortfolio practice and multimedia is a distinct advantage of ePortfolios (Rate, 2008). Using video as evidence can serve as a basis for reflection and thinking about learning progress (Love et al., 2004). Cheng and Chau (2009) used digital video for a language learning ePortfolio. Students used their personal videos as a source for reflection about their progress. This activity would be considered a form of self-modeling (Schunk & Hanson, 1989). They found in their study that this type of self-modeling increased reflection and confidence.

Students also talked about their process of creating their ePortfolio as a form of self-modeling when they discussed seeing how they had struggled with a concept and later had been successful with that concept. This is an example of internal self-modeling as described by Usher (2009). Students made references to their collaboration with other students in a way that indicated they were engaging with modeling behaviors. Schunk, Hanson, and Cox (1987) found that young learners who engaged in modeling by working with peers and observing videos of peers engaging in working on problem solving had increases in academic self-efficacy for problem solving. Usher (2009), in a qualitative study of academic self-efficacy in math, found that students with high self-efficacy

engaged in self-modeling by using self-talk and internal processes to think about themselves as capable problem solvers in math.

Sub question two (SQ2): What self-regulative behaviors do students discuss when talking about their use of the ePortfolio assessment?

The analysis found that all aspects of self-regulative behaviors (awareness, reflection, planning, motivation, and engagement) were discussed by students when talking about their ePortfolio experience. The most prevalent theme was awareness. This theme emerged during the first cycle coding as a distinct feature. According to Zimmerman (1990), self-regulated learners have cognitive self-awareness of how their effort results in learning outcomes and a self-awareness of their ability to change their work or use of strategies to improve outcomes They also must be able to understand the task and how their cognitive understanding relates to the task (Efklides, 2011). Students who are using an ePortfolio generally are more connected to the content and have more awareness of the learning process and the necessary tasks required to achieve the learning (Lewis, 2017). After the initial codes were set aside while inductive coding was employed, it was determined that the initial codes would serve as themes of the coded data. During the process of arranging the themes, the original theme of engagement was kept as a coding category and assigned to the theme of awareness. All of the students expressed an aspect of awareness. Awareness was related to self-awareness as discussed by Zimmerman (1990) and task awareness as discussed by Efklides (2011). It included an awareness of self in terms of the process, the performance, and the material. Each of these types of awareness was well represented in the coding. Examples are given in Table 4.6 of Chapter 4 such as “Holds me more accountable doing my work and making sure I

actually understand what I am doing". An additional example is from Erin's written response, "I generally am already aware of how I'm doing in a class (what I know and what I don't know), so for me personally, a portfolio is more verbalizing the thoughts I already have". An interesting point about the comment from Erin is that she included this statement to respond to what was least helpful about the ePortfolio. A learner verbalizing that they have awareness of what they are doing and how they are doing would indicate that they are already engaging in self-regulative behaviors so Erin's statement would indicate that she has high self-efficacy for this aspect of self-regulation. While she expressed that she did not feel that she had the need to verbalize her level of awareness, it was part of the expression of her experience. Self-regulated learning requires the ability to reflect on the progress and task completion of the learner and for the learner to understand and be able to express their level of success and react by making adjustments to their practice (Zimmerman, 1990). Reflection is a major focus of ePortfolios for learning and assessment (Rate, 2008). Jensen (2011) found that ePortfolio use encouraged deeper reflection for students in college writing classes if those students were given practice and feedback on their reflections. The advantage of an ePortfolio is that it gives a platform within which to engage in reflection and feedback. Explicit guidance of how to engage in reflective writing can result an increase of student focus on quality reflection (Singer et al., 2016). Since reflection is a major feature of ePortfolios and writing a reflection of each entry is required, I was expecting that reflection would be a prevalent theme. Reflection was a strong theme in that every student had data coded as reflection. However, the discussion of reflection was focused and limited to several distinct aspects of the ePortfolio. It is important to note that the student ePortfolios

contained reflective statements and those statements may have indicated the reflective behavior of a strong self-regulated learner. However, this study focused on what the students talked about when discussing the ePortfolios and not the content of the ePortfolios themselves. Therefore, the analysis does not include the extent to which students engaged in reflective behavior in their ePortfolio and instead only indicates the extent to which students included reflection as an aspect in their description of their experience. Reflective practice has been shown to be supported by the use of ePortfolios (Singer-Freeman & Bastone, 2017). The use of ePortfolios in STEM classes in particular has been shown to increase reflective practice and encouraging students to be more expressive and to think more broadly about the work that they have done (Conefrey & Smyth, 2020; Johnston et al., 2006; Piccardo & Sabourin, 2018).

Planning encompasses all features of planning and goal setting. Zimmerman (1990) indicates that self-regulation involves an intentional engagement in the work which includes thoughtful planning as well as being able to set short- and long-term goals for learning. Singer-Freeman, and Bastone (2017) found that planning by learners was enhanced when using an ePortfolio. A central focus of using ePortfolios is to shift the control to the learner which would necessitates planning and goal setting by the learners (Scully et al., 2018; Cheng & Chau, 2010). Planning was a common theme, because students were asked specific questions about goals. Each student also mentioned planning. In general, those discussions were specifically in response to the question about goals. Several students (Bria, Beth, Donny, Chuck, Tina) talked about planning and their comments indicated their planning and goal setting was a central focus of their experience.

Motivation is a central aspect of academic self-regulation (Zimmerman, 1990). Motivation is transferred into action and into the development of other behavioral aspects of self-regulated learners (Schunk & Zimmerman, 2001; Zimmerman, 1990). The theme of motivation was not a major part of how the students described their experiences. As mentioned in the analysis, one of the important features to recognize here is that one student (Karen) included motivation as a negative part of the ePortfolio experience. Karen described working with the ePortfolio as reducing her motivation. She attributed this to the flexibility and her tendency to do the minimum amount of work to get an acceptable result. Motivation was another area of self-regulation that students might not necessarily discuss spontaneously and they may not have considered it an important aspect for the end of the quarter conferences (interviews). There is a caution in two directions here. The study was not seeking to ascertain whether students were motivated or exhibited being motivated in learning physics via an ePortfolio assessment. The focus was about how they relayed their experience. As a result, I did not try to infer motivation from sources other than the interviews or written reflections. A further analysis of the coded data might result in an interpretation about the level of motivation of each student but that would be an exercise outside of the scope of this research.

Central Question (CQ): How do learners in a physics class describe the experience of using an ePortfolio as the major assessment tool of that class?

This central question was answered through combing the synthesis of the experience profiles of the semi-structured interviews and by considering the results of the two sub-questions. Individually, and as a group, the students discussed elements of self-

regulation and academic self-efficacy while describing their experiences using an ePortfolio. The elements discussed are helpful in linking the thoughts of the students.

The common themes that were identified as important to all students were: mastery and outcome expectancy (Self-Efficacy) and awareness, reflection, and planning (Self-Regulation). There were two major aspects students discussed in describing their experience. Those were the process of learning and the process of using the ePortfolio. The aspects that students used to describe the process were about the skills and practices they used to perform and to produce an ePortfolio which was related to self-regulation. The aspects that students described as to how they felt about their learning, how they thought about themselves as learners, and how they knew they had learned were about their self-perceptions which was related to self-efficacy.

To answer the central question, it is necessary to describe in general terms the experiences of the participants while being true to student voice and the variety of the individual experiences. In order to accomplish that, the central question is resolved by presenting a general interpretation of the experiences of the participants and exceptions to the general description are added as divergent experiences. For example, generally participants' descriptions of their experience include feeling successful completing their ePortfolios, learning physics, and recognizing themselves as having done good work..

The first point about the experience is about how the students felt about themselves and their work in physics. They generally reported that using the ePortfolio helped them see their growth and learning in physics. Students felt successful completing their ePortfolios and recognized themselves as having done good work. This was a finding in common with other studies. In particular Theodosiadou and Konstantidinis

(2015) noted that the use of ePortfolios elevated feelings of self and of pride of work for individual students.

The second point was students described a feeling of power or control in being able to make choices about what to work on and what to include in their ePortfolios. Learner-centeredness is a primary goal of the implementation ePortfolios in academic settings. The move of K-12 education in the direction of personalized learning or learner-centered inquiry models requires a change in assessment (Gulikers et al., 2007; Marzano, 2011; Rickabaugh, 2016). ePortfolios meet the goal of making learning and assessment focused on the learner through content, pace, method of learning, and assessment (Lewis, 2017; Scully et al.,2018; Rate, 2008). The students in this study focused on this as a major point of their experience and it was referred to as power by some students and flexibility by others. This was an area where students gave both negative and positive statements about how the perceived control impacted their experience. As an example, Karen reported that this aspect of flexibility made her uncomfortable and may have contributed to her procrastination. Tina expressed that she appreciated additional structure that was built in as the year progressed and she felt the focus on the seven science practices enhanced the ePortfolio experience. Chuck specifically pointed out that his ability to control the pace allowed him to spend more time on some aspects and empowered him to get a deeper understanding of the material as opposed to a traditional process where he would move at the same pace as all of the other students. This last point is similar to reactions of the students in the study of Theodosiadou and Konstantinidis (2015) where use of an ePortfolio encouraged students to work at their own pace and focus on their own mastery.

A third point was the aspect of awareness which is one of the central tenets of self-regulation (Efklides, 2011; Zimmerman, 2000). All aspects of the discussion of awareness indicate the students communicating aspects of self-regulative behavior. Students expressed thinking about what they were doing and that using the ePortfolio resulted in them seeing connections in the material they might not necessarily have noticed without it. Beth, Pete, and Bria put more emphasis on this than other aspects of the experience.

A fourth area of focus was reflection which is a feature that crosses between self-regulation and self-efficacy. That was seen in the crossover of some coding. Being a reflective learner creates the cognitive connection for self-regulation (Zimmerman, 2000). Using reflection as a method of self-evaluation and self-regulation is one of the purposes of having an ePortfolio as assessment. ePortfolio researchers state that reflection is an essential component of ePortfolio practice and guidance must be given to help learners improve their ability to be reflective (Jensen, 2011; Lewis, 2017; Scully et al., 2018). Students talk about the ePortfolio process as an ongoing reflection about their work and their learning in physics. Students who are reflective learners can communicate how their work fits into the learning and how the pieces of physics fit together. Using the ePortfolio requires students to frequently look back at their work. Sometimes this creates additional opportunities for learning or to connect to the current concepts. Amanda and Bria's observations both highlighted this point.

A fifth area identified was planning. This aspect involved using information to set goals and self-moderate day-to-day activities. A self-regulated learner has the capability to set short- and long-term goals and to use feedback from multiple sources to adjust

strategies (Greene, 2018; Zimmerman, 2000). It was found that participants in the current study made many references to planning and goal setting which could be generalized from different parts of the discussion. A main aspect of planning in this ePortfolio was the presence of established standards. Having established standards and expectations for outcome is important for the use of ePortfolios in learning environments (Jensen, 2011; Lewis, 2017; Scully et al., 2018). For this class the established standards were a modification of the Seven Science Practices published by The College Board for used with AP® science classes and are included in the description of the ePortfolio in APPENDIX C. Students discussed using the science practices to help them decide what to focus on. They also used the ePortfolio to help them see areas they needed to strengthen. This point was in line with the findings of Cheng et al. (2018) that goal setting for improving learning outcomes was supported by an ePortfolio practice.

The additional theme of academic stress indicated that the positive influence of the reduction of stress was found to be an important part of the experience for many of the participants. Research indicates that academic stress is negatively related to self-efficacy (Nihan, 2017; Zajacova, Lynch, & Espenshade, 2005) and self-efficacy is thought to help individuals be less influenced by academic stress. However, academic stress is a major concern for high school students and has been shown to have negative impacts on overall emotional health and academic performance (Pascoe, Hetrick, & Parker, 2020). It has also been shown to interfere with learning and the development of academic interests (Jones & Hattie, 1991). The participants in the current study overwhelmingly reported a reduction in stress and attributed the reduction to the absence of high-stakes testing and the alternative assessment methods of the ePortfolio. Several

examples are taken from the interviews. Bria stated, “I think the portfolio process makes me feel less stressed... because I can go out and I can pick what I think I did better on versus what I think I didn't do as well on and show that to you and say this is what I did really well and then comment later that I want to work more on this”. Erin stated that she did not normally get stressed from traditional classes. However, she believed that the ePortfolio helped reduce stress because it took the focus off of the grade and that it was helpful to have less stress. “A lot less stress for a lot of people (by using ePortfolio), and the ePortfolio is putting the focus on the learning instead of grades”. These aspects of the study are reinforced by the research of Jones and Hattie (1991) and Davis and Compas (1986) which found some of the major sources of academic stress were tests, grades, teachers not recognizing hard work, and making academic mistakes like studying the wrong material or forgetting to complete assignments on time.

Implications

This study has implications for schools and teachers seeking to implement learner-centered practices in instruction and assessment. The main implication is students can be comfortable having an ePortfolio as their central method of assessment. Using ePortfolio in practice is shown by the research to be supportive of the K-12 movement to shift in mindset toward a more learner-centered and inquiry-based approach (Miller, 2013; National Research Council, 2000). Personalized learning is a learner-centered model that supports the needs and interests of individual students and it requires the use of learner-centered assessments such as ePortfolios (Friend et al. 2017; Rickabaugh, 2012).

Technology does not ensure personalized learning but it has the potential to facilitate the shift to a learner-centered model (Grant & Bayse, 2014). Currently schools, such as the research site in this study, have greatly increased access to technology and digital resources for students. Implementation of technology programs supports the personalization of learning and has created opportunities that did not exist before (Friend et al., 2017; USDOE, 2016).

There is some caution from experts in the field of ePortfolios about technology. As the ePortfolio has gained in popularity and has become an aspect of alternative assessment, ePortfolio "products" have come on the market and educational technology vendors have sought to include ePortfolio capabilities into their services (Benander et al., 2017; Rate, 2008; Scully et al., 2018). These platforms can be useful, but there is also a potential for the vendor's tool to be the organizational driver of the ePortfolio practice or to interfere with the natural flow of the learner's thinking about their work (Scully et al., 2018). The more flexible a platform is, the more it can support the needs of the individual instructors and learners (Scully et al., 2018). For the implementation of ePortfolio it has to be seen as a benefit to the learning process instead of an additional hurdle to overcome (Rate, 2008). It is important for an ePortfolio to be owned and controlled by the learner and for the learner to maintain that ownership and access after completing the course or program that initiated the ePortfolio work (Jensen & Treuer, 2014; Scully et al., 2018). In this study, the ePortfolio function of an LMS was used to house the ePortfolio. However, students were given the flexibility to use another web-based media.

An important part of shifting to a personalized learning environment is shifting the focus on assessment of learning (Marzano, 1992; Rickabaugh, 2016). Assessment

should change from traditional types of assessment such as multiple-choice tests to more authentic assessments such as open-ended questions and project-based learning (Gulikers et al., 2004; Marzano et al., 1993). ePortfolio assessment has been defined as an effective type of authentic assessment that is supportive of personalized learning (Mabry, 1999; Rate, 2008). An ePortfolio is a learner-centered assessment that is interactive and dynamic (Jensen and Treuer, 2014; Scully et al., 2018).

This study provides evidence that students may be comfortable using an ePortfolio as their central assessment in a physics class. One of the biggest challenges to using an alternative style of assessment is getting learner (and parent) buy-in (Culbertson & Delongo, 1999) and having students be comfortable with the process. Parents in other ePortfolio studies have reported feeling more connected to their kids work and had a better understanding for the progress their kids were making (Theodosiadou & Konstantinidis, 2015). Having an ePortfolio accessible to parents and to elicit feedback from parents would be an important aspect. The participants in this study were encouraged to share their ePortfolio with parents. The school year following the study an additional access point for the LMS was installed to allow parents access to their students' accounts. The parents were also given observer status which allowed them to give feedback on the portfolio entries of their kids.

The shift to using an ePortfolio as an assessment for a class comes with professional responsibilities as well. This study and the literature indicate that the purpose of the ePortfolio must be made clear to students and instructors and that specific criteria should be given (Lewis, 2017; Scully et al., 2018). The participant experiences in this study reinforce that the use of standards or specific objectives are helpful in guiding

the student progress and reflection on their work. The negative indications in this study and others would suggest that those standards would need to be consistently reinforced by the instructor and a structure of reminders to submit artifacts and reflections might help support students prone to procrastination (Rate, 2008; Scully et al., 2018; Williams, 2013).

Changes in education are often made in an effort to increase achievement or student progress as evidenced on standardized assessments. While understanding achievement is important, there are other value-added aspects of learning and school that should also be considered (Farrington et al., 2012; Rutledge, 2017). The ePortfolio has been determined by AAUC to be a HIP (High Impact Practice) based on the studies that have shown ePortfolios having an effect on both academic and non-academic features of learning (Watson et al., 2016). A practice which is labeled a HIP has shown evidence in research that engaging with that practice will offer transformative learning benefits (Watson et al. 2016). The current study provides evidence that students working with an ePortfolio exercise self-regulatory skills and the literature would indicate that exercising those skills will result in a strengthening of the skills which should lead to an increase in academic success.

Limitations

There are some limitations of this study to consider. In this section, I highlight some of those. The structure of this section is limitations related to the group, limitations related to the researcher, and limitations related to the course and ePortfolio requirement.

The primary goal of this research was to understand the experience of a learner using an ePortfolio as the main assessment for a physics class. From these participants,

only a general understanding can be obtained. This group was self-selected from a class of 25 physics students at a large public high school. The group was representative of the over 200 students at the high school who were enrolled in physics for the 2019-2020 school year. Often, physics is considered an upper-level science class that only a select group of students enroll in. While this is not true at this particular high school, the students in this class represent higher-achieving students than average. From that aspect, it is possible that they had the tendency to be more flexible and comfortable working with an unfamiliar assessment system.

The second limitation of the research is that the researcher was a participant-observer. This created some concerns about validity and trustworthiness. Trustworthiness is important for qualitative research and methods to ensure trustworthiness as described by Shenton (2004) were used in this study. As discussed in the methods section, two additional individuals with qualitative research experience checked the data analysis to help ensure that coding was true to the data. This data check resulted in a change of strategy after the first cycle from deductive coding using the preliminary codes to inductive coding to help eliminate confirmation bias. The change in coding strategy helped increase incidence of coding. An additional strategy was using multiple data sources (Shenton, 2004). The questions that students responded to in writing were different than the questions asked in the semi-structured interviews. They did not easily align from the viewpoint of the participant. Even with the different data strategies, the participant experience profiles showed that there was agreement between how the written responses and interviews illustrated the experience of the participants using an ePortfolio.

There was a risk and benefit of the participant-observer role for several aspect of the study. One risk was the fact that the researcher was the teacher of the course and was assigning the grades. The data for the interviews were collected during the regular quarterly conferences. These conferences generally were held at the end of the quarter and there is the possibility of students over-exaggerating their success or enjoyment of using an ePortfolio in order to increase their chance for a good grade. This is one of the reasons that the third quarter of the year was used. Since the students had already used the ePortfolio and had conferences for two quarters, the teacher could establish a rapport that encouraged openness instead of a guarded evaluation. A benefit of this participant-observer status is that the teacher/researcher had familiarity with the students and could have insight into how truthful the students were in their responses (Bernard, 2011).

Another risk/benefit is that the researcher might read into student statements and discussion information that was not present based on the teacher's opinion about the student. The benefit of the depth of that relationship was that the teacher/researcher had some understanding of the students as learners and had a body of knowledge about that student's performance based on classroom interactions and ongoing observations. This allowed insight into a student's thinking and whether their statements about the work they had done for the ePortfolio was accurate, understated, or inflated. It also enhanced the synthesis of the narrative. Listening to the audio recording with student intonation and emphasis had more meaning to the researcher because they had a familiarity with the students and their speaking style. Each of the benefits in the paragraphs above is highlighted by Bernard (2011). This was further supported by the fact the participant-observer had been teaching science for 28 years and had been a physics teacher at the

research site for 21 years and therefore had extensive familiarity with the site and the community.

The third limitation has to do with the ePortfolio itself. An example of the ePortfolio structure is given in APPENDIX C. That represents one type of ePortfolio. The ePortfolio was based on a set of standards which were developed from the seven science practices published by The College Board to align with AP® physics classes. There are other ways of using an ePortfolio and other structures to use (Rate, 2008). There were pieces that may have been distinct to this particular experience. Most students talked about the flexibility of the ePortfolio assessment system. That may not, in fact, be an aspect that is a standard feature of ePortfolios but instead a practice that is representative of this particular class.

The physics ePortfolio was learner-centered and allowed for student control over the selection of artifacts and the amount of time spent on each type of learning activity based on established ePortfolio practices (Marzano, 2011; Rate, 2008). It is likely that in many academic settings teachers might have more defined limitations about what artifacts should be submitted and when (Watson & Doolittle, 2011). The way in which a teacher uses an ePortfolio might change the student experience. The data sources in this study were drawn from administrative aspects of the course (conferences and written responses to reflective prompts). Those resources were essentially intended to gauge student progress in the class and act as feedback for the instructor to understand what additional support might be necessary for the students. In analyzing the data, I tried to be careful to note instances when I thought that the particular aspect of the experience was

particular to this situation and not necessarily reflective of ePortfolio assessment as a whole.

While not necessarily a limitation, there was a significant event that impacted the research. The Covid-19 Pandemic resulted in the closing of the school where the study was housed. This school closing occurred on March 13th, 2020 which was three weeks prior to the end of the marking period. The progression of the school year from that date was thrown into question. Since not all students had adequate access to Wi-Fi, the school could not operate adequately in a remote learning model. The school district decided to make the official end of the instructional year the end of third quarter. Students were expected to continue to engage with learning for the fourth quarter but no new credit and nothing would be graded unless the student was interested in improving their grade. This created a challenge to present the study, recruit, and get consent forms from students. Even though it created a snag, it highlighted some of the advantages of the ePortfolio. Since it was fully digital and web-based, students had access to it on their electronic devices (computers and phones). In addition, since it was learner centered and learner curated the students could continue to make progress in the course without being in class. The course was not reliant on traditional types of assessments so there was no concern about how quizzes or tests could be administered (securely) in a virtual format.

Recommendations for Future Research

There is a push in K-12 education to move toward learner-centered models of instruction like personalized learning (Friend et al., 2017; Miller, 2013; National Research Council, 2000; Rickabaugh, 2016). This type of change includes changing methods of assessment as well (Marzano, 1991, Rate, 2008, Rickabaugh, 2016).

ePortfolio used as an assessment for a class can help create an assessment method that facilitates the move toward a more open and personalized model (Rate, 2008). This study was designed to understand the experience of learners using an ePortfolio as the main assessment for a class. Self-efficacy and self-regulation were lenses used to understand their experiences.

Future research could investigate if the way students talked about the ePortfolio was related to their academic self-efficacy for a given course. Pajares (1996, 2006) writes that a function of K-12 education should be to help develop academic self-efficacy and that purposeful practices should be put in place to accomplish that function. An ePortfolio may be an assessment strategy that helps address the positive development of the academic self-efficacy of learners and it would be valuable for research to continue to investigate this point. Does using an ePortfolio affect the academic self-efficacy of students? This question could be answered using either qualitative or quantitative measures. However, using interviews to analyze the sources of self-efficacy (Usher, 2009) and level of self-regulative skill, might give a broader or deeper understanding of the aspects of ePortfolio practice that are most supportive of self-efficacy and self-regulation.

During the course of this research, the types of artifacts were sometimes limited by the technology. Students used videos of themselves and partners solving problems as a form of modeling. Uploading the video to the ePortfolio for some students proved to be too difficult of a process and they tended to just write about their collaborative problem solving instead of submitting the actual video. There is evidence that modeling in this way has an effect on academic self-efficacy (Cheng & Chau, 2009; Schunk & Hanson,

1989; Schunk et al., 1987). A future study could consider the importance of including modeling as an embedded element of ePortfolio in developing academic self-efficacy and whether the process of making and including the video is an important feature.

Bryant and Chittum (2013) call for more empirical studies in ePortfolio research. Their position is that too many of the studies focus on student feelings and preferences and do not provided evidence that the practice results in improved performance. They do point out that there are other ways to measure learning including non-academic measures. In future research other learning benefits or benefits that might impact learning such as increasing self-efficacy or self-regulation would be important factors to focus on (Watson & Doolittle, 2011).

One element that appeared during this research but was not studied was academic stress. The students in this study discussed elements of academic stress. Some talked about how the ePortfolio created stress and some talked about how the ePortfolio reduced stress. The aspect of academic stress is an important issue in education and has been linked to academic self-efficacy (Ye, Posada & Liu, 2018). Many students in this study talked about the level of stress in the physics class compared with other classes they were in and how their own stress compared with classmates in other classes. As written in the implications, it is possible it was the atmosphere of the class that created the environment which was separate from the ePortfolio. However, many students also reported a feeling of control or independence resulting from the fact that they were the ones selecting and assessing the work. A study with a sample that included multiple teachers teaching the same course with an ePortfolio as well as teachers of other courses with an ePortfolio might clarify whether using an ePortfolio as an assessment has an effect on academic

stress. Other studies on personalized learning have shown that students having control over their learning can result in low academic stress (DeMink-Carthew & Netoch, 2019). It is important to note that the study by DeMink-Carthew and Netoch (2019) found that students having control over their learning choices experienced lower stress, but the lowered stress was reliant on a feeling of clarity of purpose of the learning. This would reinforce other literature and the current study that indicate that having clear guidelines and standards for ePortfolios is important.

Conclusion

The purpose of this study was to understand the experience of learners in first-year physics classes working with an ePortfolio as the primary method of assessment for that class. The framework for understanding the experience was through academic self-efficacy and self-regulation. The findings show that students used these aspects to describe their experiences and that academic self-efficacy and self-regulation were central to the experience.

The data for this study were collected from the third quarter activities for the ePortfolio. This ensured that the students had ample time to become experienced using the ePortfolio tools and engaging in the selection of artifacts and self-evaluation necessary. It also eliminated the novelty of using an ePortfolio as the central grade for a course. In addition, when students were writing responses to reflective prompts and speaking about their experience during the conferences, they were essentially including their entire experience from the beginning of the year. The ePortfolio is a cumulative record and students would have been engaging with the entries they made in the first two quarters while continuing work in the third quarter.

As a group, students discussed the ePortfolio in positive terms. The one student who reported “not liking” the ePortfolio still discussed positive factors and positive effects of engaging with the ePortfolio. The main points that students discussed in their experience reflected the themes of mastery, outcome expectancy, awareness, planning, and reflection. This small group of students was a distinct sample engaged in a particular academic elective course. The experience could not be generalized to other applications of the use of ePortfolio as assessment. There were particular aspects of the course, the instructor, the use of the ePortfolio, that might not be reflective of other situations..

In discussing mastery, students talked about their feelings of good work and that they felt like they had learned physics and were understanding physics. Studies by Cheng and Chau (2009), Theodosiadou and Konstantinidis (2015), and Williams (2013) supported this finding and showed that student self-agency and self-concept were among the benefits of ePortfolio use.

The students expressed how their self-evaluation contributed to their belief that they would be successful as they moved forward in the course and as they continued to work with the ePortfolio. This academic awareness indicated deep thinking about the subject and the process of learning the subject. In the same way Lewis (2017) found that ePortfolios could enhance a constructivist approach to learning where the students gained an understanding of their learning and how to improve their learning.

The students talked about how they were identifying aspects they needed to work on and how their work was sequential and linked to work completed in prior quarters. Students engaged in reflection as part of a standard aspect of the course and they also included a more general discussion of thinking about the work they had done. Planning

was an important part of the ePortfolio and in the conferences, students expressed how they used the standards to gauge what work they should do next. These aspects of learner-centeredness were also seen by Singer-Freeman and Bastone (2017) and Yastibas and Yastibas (2015).

An unforeseen aspect of this research was the sudden shift in educational format when the school system was suddenly closed because of Covid-19. Since this particular group was already used to using an ePortfolio as the method of assessment, they easily shifted to learning remotely. The school system, like most across the county, was caught completely off guard. Although the school was in its 6th year of a 1:1 program, the technological and pedagogical framework was not in place for a successful transition. In addition, even in the planning for returning to school in the fall the school system did not take advantage of the pilot program they had in place for personalized learning and most teachers returned to a traditional model. With the new challenge of needing to teach all students virtually, it is essential to find better ways to engage them in learning. Shifting the focus from the teacher-delivered curriculum to a learner-centered model is necessary.

> "Personalized learning refers to instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) may all vary based on learner needs. In addition, learning activities are meaningful and relevant to learners, driven by their interests, and often self-initiated". (USDOE, 2017).

The Technology report of the United States Department of Education for 2010 and 2017 had an important focus on the need for this shift. The sudden disruption of the

educational environment has even further highlighted this need. In order to achieve this, students need to be supported in becoming more independent learners and teachers need to be trained in transitioning to a supporting role.

In this respect, widespread use of ePortfolios would support personalized learning and the assessment of that learning. If schools transitioned to a learner-based ePortfolio system, the ePortfolio would serve as the progressive ongoing record of learning as discussed by Jensen and Treuer (2014). In this way, the students would be in control of their learning and the assessment of their learning.

In order for educational leaders to make this shift it will be necessary to have a good understanding for how students engage with ePortfolio assessment. This will require both quantitative and qualitative research. It will be essential to understand what methods produce the desired results and how to reframe what desired results might be. It will also to be essential to understand the experience of the learner in order to be able to adequately support the ePortfolio process from an instructional standpoint. This study provides insight into understanding the experience of learners using an ePortfolio and could serve as a start point for future efforts to expand that understanding.

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APPENDIX A

Guidelines for Developing Self-Efficacy Scales

(Summarized from Bandura, 2006)

1) **Content Validity**
    i) Items should reflect construct
    ii) Phrased with “can do” rather than “will do”
    iii) Distinguish from other constructs (self-esteem, locus of control, outcome expectancies)
2) **Domain Specification and Conceptual Analysis**
    i) Reflect factors related to the relevant domain
    ii) Linked to factors that determine quality of functioning
3) **Gradations of Challenge**
    i) Reflect the level of difficulty an individual believes they could surmount
    ii) Consider the self-regulatory efficacy of individuals
    iii) Sufficient proposed difficulty to avoid ceiling effects
4) **Response Scale**
    i) Should have enough gradation to allow for variation (0-100 or 0-10)
    ii) Only positive values
    iii) Specified time frame not hypothetical future
    iv) Unrelated practice items to establish meaning of scale
5) **Minimize Response Bias**
    i) Anonymous Response
    ii) Label with non-descript title such as “Appraisal Inventory”
    iii) Present in a manner to reduce social evaluative concerns (understanding rather than judgement)
6) **Item Analysis in Scale Construction**
    i) Check for Abiguity
    ii) Remove questions without variation of response
    iii) Remove questions that max or min the majority of responses
    iv) Test and group by domains
7) **Perceived Collective Efficacy (Where group efficacy is the target)**
    i) Construct from a combination of individual and group evaluations
    ii) Avoid assessments that are susceptible to social influence
    iii) Consider contributing factors of context and domain
8) **Predictive and Construct Validation**
    i) Evaluate difference between individuals with high and low self-efficacy
    ii) Verify predicted effects
    iii) Ongoing process of evaluating causal structure

APPENDIX B

Student Experience Profiles

Created using a narrative inquiry style as summary

Pseudonym	Narrative and Analysis of Experience Profile
Hakim	Hakim expressed a feeling of control and that he appreciated having choice in what he would present as evidence of learning. He discussed feeling successful and that seeing his work in the ePortfolio makes him feel good because he can see that he has done good work. The ePortfolio process made learning physics easier for him. He also stated that using the ePortfolio makes him feel like he is moving forward in the class and it makes it easy to see his progress. His expressions of confidence and feeling good about his work are a little bit in contrast to his behavior of focusing on the procedural points during the interview. This behavior made it seem like he might not be as confident as he states. In his written reflections he also expressed a concern that he might not always know if everything is "right" when he puts it in the ePortfolio. He did express a feeling of progress overall. In his written responses he wrote, "Having the choice of what to put and not to put made feel much better and made me do better work"
Beth	Beth views the ePortfolio as a valuable learning tool. She expresses a feeling of pride and confidence in the artifacts she includes and experiences that the ePortfolio highlights. She focused on pride and confidence in both her responses to the written reflective prompts and in the interview. She used the ePortfolio as a way of looking back at her work and thinking about what she had learned in the class and how each artifact shows something about her progress. She also discussed looking back at work and making corrections when she recognized something wasn't quite right. Beth also discussed that using the ePortfolio made her feel comfortable addressing areas that she recognized as weaknesses and to keep working to make improvements. She mentioned in both the interview and written responses a lowered level of stress in the class compared to other classes that she attributed to the use of ePortfolio as opposed to traditional grading. She contrasted the two as learning as opposed to getting ready for a quiz. She mentioned learning and making progress. The ePortfolio made her feel engaged in the process of learning physics. She expressed a feeling of power and control over what was included and what would be evaluated. Confident that she has been successful in physics as evidenced by the artifacts and her written reflections about her work. Beth seemed to feel like the ePortfolio was a benefit to her learning. Both her interview and her written responses indicated that she felt successful in the class and in using an ePortfolio. She is one of the students who had not used an ePortfolio in the yet expressed being confident and comfortable. A statement in her interview that summarized this was "Tests tell a day the ePortfolio tells my work".
Samantha	Samantha highlighted that it was helpful to have the ePortfolio because she could go at her own pace and could get extra time to complete work if she needed it. In the interview, she talked about occasions where she did not fully complete labs and using the ePortfolio allowed her to wait and then go back after more fully understanding the mathematical pieces to complete the lab before putting it in as an artifact. It seemed important to her that she could determine the pace of work and mentioned several times that it felt less stressful. In her interview she relayed that one of the

	things she liked about the ePortfolio was “I can go back and see the things I did well and the things I have to work on”. Samantha seemed to be comfortable with the fact that she was delaying completion of activities or would go back and revise her work when she learned something new.
Pete	Pete expressed that the ePortfolio lowers his stress and allows him to see what he has done well on and where he needs to improve. He discussed that the ePortfolio really shows his work and his work ethic. He viewed the ePortfolio as part of the learning process. A process of looking back at what he did and to see how the activities fit together. He used the ePortfolio to help plan what he would spend more time on. If he noticed one of the seven practices (standards) did not have much evidence, he would focus on addressing that evidence in his future work. He also discussed using the ePortfolio as a way of comfortably evaluating himself. He could see that he might need to do more work or to be more focused on having all of the work in his digital notebook. He recognized that he relied too much on his lab partners to submit the work and even though he could describe exactly what meaning the lab held, he did not always have the graphs shared in his notebook. Building the ePortfolio allowed him to go back to his notebook and fill in the places he was missing things. He felt more responsible for himself and he wasn’t relying on the teacher as much. In his interview he talked about the fact that he could be missing things with no penalty because the ePortfolio relies on a meaningful selection. He stated “the teacher doesn't grade you on like every single assignment you've done. Instead, you can say hey this is my best work, and this is work that I posted. That you know that I want to improve on”. I noted in the transcript that this was spoken with emphasis. Pete focused on reflection and feelings of comfort. He was comfortable enough with the discussion to be self-evaluative about the fact that he did not actually have all of the lab data included in his ePortfolio because he let his lab partners submit it and hadn’t linked it to his own lab submission. He recognized this as an aspect he would have to correct moving forward.
Tony	Tony expressed his feelings about the ePortfolio as an opportunity for learning. The ePortfolio helped keep him thinking about what he was doing and how each opportunity was part of the bigger picture. He also said that he used the ePortfolio to help him learn. He would often look back at his entries if he was confused about a new concept and would use that to help him figure it out. He also expressed that he felt comfortable putting artifacts in his ePortfolio that didn’t initially seem like his best work, because he could use those to talk about his progress and to show where he started on a topic or with practice. He also noted that the ePortfolio lowered stress because the course was not “assessment central”. While working on the ePortfolio he sees himself as “doing good work” and that it helps him feel like a successful learner in physics. He also said putting the artifacts in the ePortfolio and reflecting on them often made him think about physics outside of class and to make connections between his labs and things he does. He gave an example of a lab about friction and then was thinking about the different types of surfaces he plays soccer on and how there might be a connection. He was proud of his ePortfolio and said that he often would touch up labs before putting them in because he wanted it to look good. He felt that the

	ePortfolio process allowed him to learn in his own way and that he got to determine what was important and what was significant about his work. Tony's focus was on the lowering of stress and the feeling of being successful. He was using his portfolio as a guide for understanding his learning in physics. It seemed that the grade being reliant on the ePortfolio instead of traditional methods was enabling him to think more broadly about his learning.
Bria	An important feature seemed to be that Bria felt as though the flexibility met her personal needs. Expressed the flexibility of going faster in some activities and slower in others. The ability to go back and revisit an activity or to skip ahead and then return to something she had worked on earlier. Bria also noted the connection between the quarters. Instead of having learning defined by the quarters, she made connections from one quarter to the next and used activities from one quarter to the to help her understand activities in the next. Having the artifacts in the same place she was able to see how the math concepts transfer from one aspect of physics to the next. Bria discussed the convenience of being able to see everything in the same place and that it helped her show her process of learning. The ePortfolio encouraged reflection and encouraged using previous work as a reference for new work. She did note that the process was subject to procrastination and she recognized a need to be more proactive and to choose things for the portfolio as she went along. She specifically discussed the seven science practices (standards) that helped her better understand the importance and relevance of her work. She felt that her ePortfolio shows good work and shows that she had been successful in learning physics. She was confident in her learning and understanding physics. Bria was confident about her ePortfolio and confident about her performance. She seemed to like the continuous ongoing evaluation of the ePortfolio so that her work from the beginning of the year was still relevant in the third quarter.
Donny	In the interview Donny talked about the fact that he had used an ePortfolio in another class during an earlier school year. He talked about the similarities between these two events and felt like he was more successful with the ePortfolio now because he was a little older and understood what he was trying to accomplish. He also mentioned that in this ePortfolio he was given (or felt like he had) more independence to decide what he would include as his artifacts. His big takeaway was that using an ePortfolio allowed him to focus on what he was learning instead of just trying to get it done. He thinks about what the product should look like in order to have his ePortfolio "work well" He acknowledged that he looked for his products that showed his best work. He also mentioned that this process made him feel more organized and he felt like he was being a better student because he was doing things for a purpose and was thinking about why he was doing them. He said the focus was on "getting knowledge instead of a grade". An important aspect of Donny's discussion was about the fact that he had used an ePortfolio when he was in 9th grade and felt more successful this time around. His thoughts about it being that he was older and more mature are interesting. It is in line with the idea expressed by other students that their ePortfolio improved as the year progressed.

Amanda	Amanda described in both her reflective prompts and in the interview how much she liked the ePortfolio. She described the process of using an ePortfolio as being graded "holistically". She also specifically talked about the ePortfolio being supportive of the transition to virtual learning because she was more reliant on evaluating her own work. She mentioned in both sections that she was proud of her work and proud of what she has accomplished. She stated several times that it allowed her to show learning in several different ways and that using an ePortfolio encourages her to master physics in a variety of ways. During the interview she mentioned several times that the ePortfolio incorporates "all of your learning into consideration" and that it "assesses my learning as a whole". She also stated several times that she did not have to spend time doing things she understood and could focus on the areas she needed to improve. She gave an example of math problems as things she could do and designing labs as something, she wanted to spend more time working on because it was an area she needed to improve. She also discussed using the seven science principles as guides to help her know what areas to focus on. She mentioned that if she would go back through her entries in her ePortfolio to see if the practices were addressed or could be addressed if she modified them. In the interview she seemed to focus on not having to spend time on what you already know. That if you do a couple of problems and you understand it you can move on and not have to do every example. One interesting point is she said she felt the ePortfolio grading improved her confidence, because "I am not afraid to ask for help and everything doesn't have to be perfect". Amanda's interview seemed to be focused on how the ePortfolio gave her control over what she had to spend her time on and that it was a broad picture of her achievement in physics. The one negative that she talked about was that it was easy to procrastinate. That is an interesting note because she is one of the students who was consistently up to date and proactively turning assignments in for feedback in a timely manner.
Austin	Austin expressed liking the ePortfolio and talked about the fact he had it in his biology class freshman year as well. He talked about the fact that he liked that the ePortfolio gives you an "opportunity to show what you know rather than be penalized on what you aren't sure of". In his written reflection he talked about being more motivated because he was allowed to choose which artifacts to use. He also stated that the ePortfolio helps him process because he sees things twice. Once when he does it and once while writing about it for his ePortfolio. The one issue he understood was that he did not complete it in time. He expressed that having one due date made him try to do it all at once. He thought that if he had deadlines and reminders to put entries in his ePortfolio it might help. The ePortfolio is an ongoing process and a "bad grade" for turning it in late is an artificial motivator which can be removed once the ePortfolio is completed. That is the case for Austin. He appreciated the fact that his grade was low because he had not completed the requirement. Part of his explanation was that he wanted to check over his work to make sure it was up to standards. His work in the end was decent and was thoughtfully completed. He obviously liked the flexibility of the system.
Chuck	Chuck describes liking the ePortfolio and the process of having the ePortfolio determine his grade. He expressed that "You don't have to understand everything… you are graded on what you learn "He also

	described that the ePortfolio helps him to know what work he needs to do and that it was helpful to have to explain how the evidence relates to the science practices. During the interview and in his reflective response he discussed having a difficult time deciding what evidence to use and felt like he needed more guidance about specific pieces of evidence that should be included. To highlight this, he talked about that he had made progress in beginning his ePortfolio on time and not procrastinating except he found himself waiting to get to a lab or activity he felt comfortable with to add things to his ePortfolio. He explained that it would have been better for him to stick with it and felt like he was not putting enough effort into the more complex activities. A theme for Chuck was that he liked the ePortfolio because he felt like he could not know how to do something and still get an alright grade but was almost using that to let himself off the hook. He was fairly self-reflective about his practices and talked about needing to follow through and stay on task more.
Ed	Both in the interview and in the reflective responses Ed indicated that he thought that the ePortfolio was beneficial to student learning. While working on completing the ePortfolio he would think about how he progressed during the quarter and the year. He said that he enjoyed the process and reiterated in his interview that he really enjoyed it. He mentioned that it motivated him and made him comfortable looking at his strengths and weaknesses. In his reflective responses he wrote that he believed "ePortfolios are an honest assessment". An interesting aspect of this interview was the discussion of enjoyment of looking back. Several times in the interview and several times in the written responses he mentioned enjoyment of working with the process. I find that interesting, because students will often say they like something, but the term enjoyment seems to me to be a more purposeful or personal statement. That issue struck me so that I went back and looked at the data from the quarter before. In that quarter he said he somewhat enjoyed it and at the end of third quarter he said he really enjoyed it. An interesting progression since we had just moved to virtual school.
Tina	Tina described her experience using the ePortfolio very positively. She stated that the ePortfolio allows her to demonstrate what she knows and is proud of the work that she submits. Reviewing her work in the ePortfolio makes she feel more confident and she sees herself as a good student in physics. One of the reasons she gives for the experience being positive is that she has learned how to manage the process of using the ePortfolio. She learned from her experience in the first and second quarter that it is important to begin early and build the ePortfolio as you go along instead of doing it at the end. She found that when she was building it in real time, knowing the things she was working on would go in the ePortfolio was a motivating factor. She described that the ePortfolio made it easier to set goals and setting the goals made the ePortfolio easier to create. Tina described herself as a bad test taker and feels like traditional grading is not an accurate measure of her learning. At the end of her interview, she talked a lot about the stress she experiences at school. For her the ePortfolio was about learning and removed a lot of the stress of worrying about what her grade would be.

Shania	Shania talked about the ePortfolio being a motivating factor. In her written reflective responses, she specifically mentioned the motivation coming from the ePortfolio. “Knowledge I will be creating an ePortfolio motivates me to do my best work, so it is good enough to include”. She also discussed reflection as a primary skill that she used. She reflected on the work she did and on the science practices she used to do that work. She found collaboration on lab activities and problem solving to be helpful and extended that into the creation of the ePortfolio. Her group discussed how each activity would meet the seven practices and would add things to the activities to include more standards. She felt like the ePortfolio held her accountable to her work and that she had to “reflect and remember” what she had done. The negative aspect she mentioned was that if you slack off in class you have to go back and fix things (which she then indicated would actually be a positive) Shania valued her independence and thought that the ePortfolio supported that. She really spent a lot of time talking about reflection and thinking about herself as a learner. She was as interested in how she was learning physics as she was how well.
Karen	The aspect that Karen struggled with in the ePortfolio was the openness and the freedom. She described having good intentions of doing the work on time and putting it in her ePortfolio, but that since there was not always a firm due date and exact time it would be graded, she would often procrastinate. She discussed the fact that the ePortfolio made her very aware of her shortcomings and that was a main feature of how she felt as a student using the ePortfolio. She described having difficulty staying motivated and relying too much on just putting the minimum amount of work in the ePortfolio. When she looks at her ePortfolio she thinks she should have done more work. Even with her aversion to the ePortfolio she sees advantages in that it allowed her to self-evaluate and that it gave her the chance to talk about her learning. She discussed that she liked firm deadlines and for grading to be rigid. She thought that she would commit to staying up to date 4th quarter and that using the ePortfolio influenced that plan and then added “But I still don’t like it”. Karen and I had talked about her ePortfolio on multiple occasions and she had made it clear that she felt like that system was at least partly responsible for her tendency to procrastinate and get behind in her work. She ultimately produced an acceptable ePortfolio and her dissatisfaction had to do with her own high self-expectations of excelling instead of producing something acceptable.
Jerome	Jerome described reflection about his work as one of the important aspects of the ePortfolio. Both in the interview and in the written responses he described the ePortfolio process as “neat” and “fun”. He mentioned that using the seven practices made him think about how to do work and why the work was important. He felt like trying to look over his work later on was difficult, because he sometimes didn’t write very extensive responses. He noted that he was going to start writing concise notes to himself about what he had done, so that he would understand it later. He also spent some time talking about that the ePortfolio allowed him to go at his own pace and provided extra time to master concepts. He described feeling like others were mastering material earlier than he was

	and felt like the ePortfolio removed the pressure to keep up and instead he could "learn at a good pace". Jerome's self-reflection that his learning pace was behind others was not accurate. He tended to be a student who would help others in his group understand and tended to more quickly and more thoroughly gain mastery of the material. It is interesting that his perception of the ePortfolio was that it made him comfortable with his pace of learning. He did describe a contrary example being math class where he would feel just about to really understand something and then it would be time to move to the next topic.
Jane	The primary aspect that Jane referred to is the organization of the ePortfolio and how it was easy to organize her artifacts and using the ePortfolio encouraged her to organize her work more. She describes progressively throughout the year using more planning on her ePortfolio and in the third quarter she started with an outline. She stated that using the ePortfolio" encourages me to pay attention to what I am doing". She also discusses that she likes writing the explanations and using the science practices to describe her work and her progress. When she reviews her portfolio, it gives her a chance to check to see if she understands the concepts. She likes the independent style that she doesn't just listen to lectures and then take a quiz. She also liked the fact that concepts she learned were still important to her future work. In looking at her work in the ePortfolio it makes her feel competent, like she knows what she is doing. Jane was one of the few students who discussed changing her approach to the ePortfolio based on her experience. She started her portfolio earlier during second quarter and in third quarter she started by organizing how she wanted her portfolio to be and was putting artifacts in as she went along. She made lots of comparisons between her experience in this class and past science classes where she did not feel as comfortable or competent.
Erin	Erin discussed liking the ePortfolio process in her interview. In both the interview and in her reflective responses she expressed being proud of her work and feeling good about herself as a learner. She also described that the ePortfolio was challenging. She felt challenged by the work she was doing and an additional challenge to put her work in the ePortfolio and describe how it illustrates the science practices and standards. She starts her ePortfolio by including assignments she feels are significant parts of her learning and then uses the science practices to discuss them. She states that this process exposes areas she still needs to work on, and she adds to the assignment of looks for additional evidence. Erin describes a comfort with going her own pace and that the ePortfolio encourages understanding instead of simply checking off all of the problems. She likes including problems and thinks that is important to be sure she shows she understands. She makes a comparison to traditional grading. She asserts that she is not stressed by a traditional method but feels like an ePortfolio is qualitatively different. She says the ePortfolio "is more relaxed and independent. The focus is off the grade and trying to get every point". Erin is an advanced student and described that she would have been comfortable in a class where grading was traditional. Even with that she described advantages that the ePortfolio has for advanced students. The

	independence and the focus on learning was important to her and she mentioned it several times and several different ways. She used the term "capable of knowing" when describing what the ePortfolio indicated about her as a physics student. She gave that after a very long pause, and I thought it was an insightful evaluation of self.

APPENDIX C

ePortfolio Instructions Included with Syllabus for the students in the study

Physics e-Portfolio

2019/2020

Purpose: The purpose of using an ePortfolio grading system is to support Standards Based grading and to give students an opportunity to thoughtfully compile evidence of mastery of the objectives and to reflect on their progress toward mastery. An e-portfolio facilitates this further. An e-Portfolio can be more easily updated as progress is made. A student could add evidence regarding first quarter objectives during second, third, or fourth quarter. The ultimate goal is for each student to master the curriculum. Standards-based grading allows for that to occur at different paces for different students.

Process: The summary of the ePortfolio will be used to establish the grade at the end of each quarter, the end of the semester, and the end of the year. While the summary occurs at distinct points, the evaluation and feedback of the portfolio will be ongoing. Each unit should include a thoughtful selection of evidence for each of the seven science practices. The portfolio will be a place for the teacher and the student to communicate about challenges and successes. Throughout the quarter there will be student-teacher conferences to establish a working understanding of student progress. Conferences may be individual or with small groups of students.

Evidence Selection: There should be one piece of evidence (artifact) for each of the seven practices for each of the units studied. The reason this artifact is selected should be clear and the student should thoughtfully describe their reasoning. A student may replace artifacts at any time to provide evidence of further mastery. One artifact may serve as evidence for more than one of the seven science practices. The student should make sure

to clearly delineate which of the seven practices are addressed and explain fully the level of achievement.

Table APPENDIX C Seven Practices, Meaning, and Types of Evidence

Science Practice	Meaning	Types of Evidence
Use representations and models to communicate scientific phenomena and solve scientific problems.	Being able to graphically represent physics concepts. Understanding how to use a drawing or other representation to exemplify a physics problem.	Force diagrams, field diagrams, projectile motion drawings, charge distribution and charge separation. Multiple choice questions.
Use mathematics appropriately.	Understanding what formulas can and should be used to solve problems numerically. Being able to use multiple mathematical methods to solve problems.	Solving a physics problem using math. Setting up and solving simultaneous equations. Understanding trig functions and superposition principle. Multiple choice questions.
Engage in scientific questioning to extend thinking or to guide investigations.	Understanding how to use experimental design. Designing meaningful experiments.	Open inquiry lab activities, experimental design questions, science projects.
Plan and implement data collection strategies in relation to a particular scientific question.	Understanding how to execute an experimental design. How are variables selected and how can the variables be changed in a meaningful way to collect data? How will the data be used to answer the question?	All lab work. Open inquiry lab work (more specifically). experimental design questions. Science projects.
Perform data analysis and evaluation of evidence.	What mathematical methods can be used to manipulate experimental data to answer a question. How can data be graphed to produce a model or verify a formula using experimental data?	All lab work. Data-based questions. Other data-based questions. Independent research. Science Projects.
Work with scientific explanations and theories.	Be able to write coherent paragraphs discussing physics phenomena. Be able to read and understand discussions of physics phenomena. Be able to evaluate statements about physics to determine their validity.	Lab work (introductions and/or conclusions).Discussion questions. Peer feedback on lab work. Science project introductions. Problem sets. multiple choice problems.
Connect and relate knowledge across various scales, concepts, and representations in and across domains	Understanding the connections between the distinct units of study. Energy and work for example. Being able to convert units and understanding the subunits of derived units. Example: How is $\frac{Fd}{t}$ the same units as VI (they are both Watts).	Problem sets. Open Inquiry and other lab work. Class notes and reflection on class notes.

Overview: While each artifact will be selected and described, the student will also create an overview of the portfolio. This overview will be the student's reflective discussion of the evidence. It should be meaningful and ongoing. The overview should seek to make a connection of the seven science practices across the concepts. Through this process, the student should become aware of strengths and areas to work on. For example, a student may discover that they can easily solve problems mathematically once they are set up and they understand which formula they need but that they struggle to understand how to set the problem up to start with. That student might come to understand that they need more work on Science Practice #1. As the year progresses, they can choose to focus more on that practice and can spend less time on the mathematical solution. (Setting lots of problems up and solving a few).

Big Picture: From the outset, this can look overwhelming. It may seem like a lot of artifacts and non-physics writing. That may be true in the beginning. The goal is for you to build your understanding of physics at the same time you build self-awareness as a physics student. If you more completely understand the physics and the problems you are working on, you will find it easy to select artifacts that you believe demonstrate your achievement. We will have ongoing conferences to ensure that you have the support necessary to be successful. You will have plenty of opportunities to get help and to ask for guidance on artifact selection.

APPENDIX D

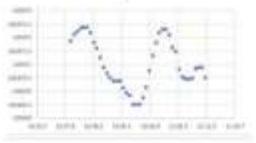
Examples of ePortfolio Pages

These were taken from classes not included in this study that had the same ePortfolio requirements

This is a series of 4 Google slide that a student has included in their ePortfolio. The link to the slides was posted in Canvas. There are links to the original lab work embedded on the slide and each slide contains a reflection. Elsewhere in the ePortfolio there are additional slides with overall reflections.

Pressure Lab 1- Static Fluids

This lab was interesting because we were able to discover what factors influence pressure on a static fluid. We concluded that as the pressure increased the water density increased. As the depth increased, the pressure increased. We found this by testing out different depths and measuring the pressure. That is also how we found density. I engaged in scientific questioning to extend my thinking and to guide investigations. I also connected and related knowledge across various scales, concepts, and representations in and across domains. Finally, I performed data analysis and evaluated evidence while using mathematics.



First quarter assignment

I really liked the can of stuff assignment because it made me have a better grasp on physics. Using something from around my house and physically measured it felt nice because normally we would be doing physical labs in class. It also refreshed my memory of having to convert grams to kilograms. I really like using OpenStax because it is clear and helpful. I also picked up a textbook last week and am planning to start using that more to give my eyes a break from screens!

Danny Deckchair- static fluids

This lab was confusing at first but once me and my lab partner worked it out, it allowed us to better understand the Buoyant force. We used math and performed data to determine the buoyant force, the balloons acceleration and how many it would take to lift one of us off the ground. We also used outside sources like OpenStax to help lead us through. My favorite part of this was determining how many balloons would hold us because it made it more understandable and easier to comprehend the buoyant force in real life.

Danny Deckchair
1.
Pf=ρgv
Mass of helium= 3.058846*10^-4
Volume= .030568
Mass of balloon+mass of helium= .0253056 kg
D= m/v= .8278468

Buoyant Force=ρ .030568(.8278468)(10)= .253056 N

To lift Katy off the ground:
533.787 Newtons
(533.787)/10=
5337.87/BF= 21093.83145 Balloons

Acceleration of the balloon:
diff=acceleration

2.15m/1.4s= 1.54m/s
Change of position= 1/2a t^2
.5(1.54)(1.4)^2=1.5

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To lift Katy off the ground:
533.787 Newtons
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Acceleration of the balloon:
diff=acceleration

2.15m/1.4s= 1.54m/s
Change of position= 1/2a t^2
.5(1.54)(1.4)^2=1.5

This is a page from the Canvas (LMS) ePortfolio. It allows for similar features as google docs. The advantage is that for the students they can more easily link their assignments directly into the ePortfolio as soon as they submit them.

Charge and Force

The submissions for this assignment are posts in the assignment's discussion.
Below are the discussion posts for [redacted] you can **view the full discussion**.

from **Electrostatic Charge** [redacted]

The picture is difficult to see, but I charged my hair and this brown sweater by rubbing the two against each other and creating an attraction. Because of this, when I pulled the sweater away from my head my hair followed it.

Attached File: **1610478622.445636.jpg (https://apsva.instructure.com/files/8721736/download?verifier=VJT2WZWeZsXgvB0dLrNuz9g6Ze5jNdBlV3lvfOQt)**

Paper View

- What does it mean - for an object to be "charged"?

Charged objects have either more negative electrons than positive protons or vice versa. Objects or atoms with more electrons than protons are charged negatively; objects with more protons than elections are charged positively.

- How can you charge the balloon?

By rubbing the balloon on the sweater, you can charge the balloon as it will pick up electrons from the sweater and become negatively charged.

Paper View

Electrostatic Charge Discussion - It was kind of fun to take the picture and find this. I like applying these concepts to things in my house/real-life.

Electrostatic Charge Assignment - This assignment was really easy, I feel like I did this same simulation in Physics last year. Very straightforward, but good memory jog regarding electrostatic charge and the general concept.

Electroscope - This simulation was pretty self-explanatory, nice to have continued practice. It also reminded me about the concepts of induction/conduction.

Page Comments

No Comments

Add a New Comment:

Add Comment

APPENDIX E

Themes and Sub-Themes

Self-Efficacy Sub-Themes: SQ 1

Sub-Theme	Definition	Categories	Example Learner Statements
Mastery	The perception of having been successful in domain specific tasks and in learning. The student expresses feeling successful or that they feel successful learning physics. They are confident in their learning and are confident that the work in their ePortfolio shows they were successful. The student reports being a successful learner and talks about learning specifically. Student presents their learning in holistic terms and describes how they demonstrated success in multiple ways.	Feeling of good work	I see work that I'm proud of rather than just looking at tests.
		Focus on learning	You can see yourself doing the work and see yourself connecting the ideas and making it look good
		Learning process	It shows the aspect of knowing how to do the equations. I know how to do this and it means I understand.
		Confidence	It reflects on how good I am as a student in physics doing the ePortfolio

Sub-Theme	Definition	Categories	Example Learner Statements
Modeling	Using examples of successful task completion to gauge progress. The use of observation of others or observation of self in order to modify performance. This includes discussions of collaboration and group work. Students report using the example of other students or their own example to facilitate learning. Students describe using the artifacts in their ePortfolio to help them on new tasks and challenging concepts.	Collaboration	Part of that was working in groups and helping to explain stuff to other people. I think a lot of the time I felt like I understood the content well enough to explain it to other people which I feel is a good indicator for me.
		Informs learning	The portfolio gives you one place where you could go to and see if it'll help... it'll help you later on
		Opportunity to show success	One of the assignments I really liked was where you would solve a problem on the board and take a video of it. I think that it shows I can solve a problem and I can prove I understand it.
		Observation	I did like when we did the videos and shared them on canvas, I thought that was interesting. Because again, my way of doing it might be different than someone else's way. I think that's helpful.

Sub-Theme	Definition	Categories	Example Learner Statements
Outcome Expectancy	The expectation of a particular result based on personal effort or activity. Student discussion of expectation of course outcome based on the specific work they have done. The student states that since they have demonstrated the necessary skills they have been successful and their ePortfolio will demonstrate that success. The student has made a personal investment and expresses a responsibility for the assessment or outcome. Through self-assessment the student may identify areas to improve and spend time working on those areas. Learners have some control of which artifacts are included in the ePortfolio to be used for the grade.	Learning means success	I mean you knew the information. You show whether or not you can do it and you get your grade based on how well you try and how well you show an example of it
		Engaged in process	I will do my work in the future because if you don't do any of the labs, you won't have anything to put into your portfolio, therefore you don't have any proof that you learned the standard
		Choose easy path	When I slacked off on a lab you are held accountable and you have to fix it.
		Feeling of control	I do my best on or that show more fully demonstrate my knowledge more than other things,. I definitely choose things that represent my capabilities and knowledge more. I definitely use assignments that demonstrate my knowledge.
Use of Feedback	Getting feedback from multiple sources and using the feedback to adjust behavior. Feedback could be self-generated or externally given by peers or the teacher. The student specifically discusses using feedback given on particular tasks. Self-feedback recognizes that improvements to an artifact or to the general portfolio. Student expresses an understanding for when things are well done and that they will attempt to replicate the efforts. Discusses using the feedback to improve performance.	What worked	I was going back and … I was relearning the content I already learned. The part where I look back at all the work I did and remind myself of what I have had learned
		Self-Correcting	I wish that I had been more proactive and created my portfolio as the quarter went on, but that is something I can fix.
		Self-Assessment	I was not afraid to fail or ask for help and everything doesn't have to be perfect all of the time. You can do like do more to show you know it, if the first thing doesn't work out for you there are always more opportunities and chances to show you learned something
		Areas for Improvement	It again showed me what areas I needed to work on for the rest of the quarter

Self-Regulation Sub-Themes: SQ 2

Sub-Theme	Definition	Categories	Example Learner Statements
Awareness	Being aware of the processes and behaviors necessary to be successful. The student expressed understanding their role in learning physics. They talked about the actions they took and what they did to make progress. There was discussion of the connections between their work and connections illustrated throughout the content. Students talked about using different methods or that they have included multiple or varied representations of work.	Connectedness	I would say oh I didn't know that (math) also transferred to over here... Just making those different connections that I think are helpful
		Learner focus	Holds me more accountable doing my work and making sure I actually understand what I am doing
		Engagement in task	ePortfolio encourages me to pay attention to what I am doing.
		Learning process	I had to have it in mind as I was writing it. I said ok this is what I have to talk about.
Motivation	Thoughts and feelings behind the reasons for doing the work. The student discussed being motivated to produce work that will reflect well on them, will show what they know, and show what they can do. The student also talked about thinking about prioritizing work that they felt was important or would have a positive result.	Prioritization of work	The knowledge that I will be creating an ePortfolio serves as motivation to do my best work so that it will be high enough quality to include in that quarter's portfolio.
		Enjoyment	Makes me more motivated to work on the topics that I enjoy and love doing.
		Desire to do well	You see yourself doing the work and see yourself connecting the ideas and making it look good.
		Internal/External	I like having hard deadlines and stuff so the ePortfolio is a little hard for me (reducing motivation)

Sub-Theme	Definition	Categories	Example Learner Statements
Planning	Goal setting and creating the structure to accomplish tasks. This included discussion of actively thinking about what experiences will enhance their ePortfolio. Students talked about the organization necessary or have developed in order to be successful creating an ePortfolio. They discussed setting goals for completing or compiling work and how they used the learning standards to make those decisions.	Goal setting	I found that it is easier to be putting things in during the quarter instead of just waiting until the last week.
		Flexibility	It gives you more time to space things out... you can still know maybe I can plan this out where I have to put one or two things in every one or two weeks so I have something in there.
		Revisiting Work	The portfolio is helpful because I can also put something in where it's like I didn't understand this but then in the next lab oh but now I understand it with this lab and I can fix it.
		Use of standards	I add the science practices in. I try to find an assignment for each one. I thought how each activity would meet the seven practices and would add things to the activities to include more standards.
Reflection	Thought or consideration of the aspects and progress of learning. The student used the ePortfolio to think critically about their work and their progress. They discussed making decisions about revising or revisiting assignments based on new experiences. The student talked about how the ePortfolio made them think about their successes and challenges learning physics.	Overview	I got to reflect on like what parts of physics I was using on each lab and which content related to it.
		Comfort in Challenge	I have to explain how it relates to the concepts or how it relates to the stuff we're supposed to be learning in class. So, I really put a lot of work into it.
		Rethink	Going forward I am going to write them in a way that I am going to understand them when I look at them later.
		Arm's Length	I think it is very helpful for some people. I personally prefer getting graded on the work that I do. So the ePortfolio doesn't really work well for me.

APPENDIX F

Study Timeline

Study Timeline

The data was taken from the portfolio reflections and student teacher conferences from the third grading quarter. This represented the portfolio produced during a ten-week period of engagement with a distinct unit of study. Since the data was taken from the material produced during the regular process of evaluating the students for the course, the consent sought from the students and the parents was only for their agreement that the data already collected could be used in this study. The process of informing parents and students about the research and collecting the required "agreement to participate" from students and parents occurred after the grades for the year were submitted and were a matter of permanent record. Electronic consent forms were delivered to parents and students via email after the fourth quarter had begun. No data was accessed or analyzed until after the close of the school year when the grades were made permanent. During the two grading periods prior to the analysis, the students were being introduced to ePortfolio as a course assessment and have that period of time to build the practice of the ePortfolio. This was to ensure that the student experience was not unduly influenced by the novelty of the experience and to help build the trust required to make students comfortable being honest in their reflections and to speak freely during their conferences with the instructor-researcher. Keeping the study within the timeframe of one grading period also helped to isolate the units of study that will be engaged with during that time period. No additional data was collected because the school year essentially ended after the end of third quarter because the Covid-19 pandemic resulted in the early closure of school.