Authentic Learning with Portfolios: A Combination that K-12 Education Needs

by

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Abstract

Education systems play a critical role in sustaining a society by equipping citizens with the mindsets and skills necessary for professional and personal success. The American K12 education system has unfortunately not kept pace though with the demands of the 21st century. Students need systemic changes that make learning more meaningful and more engaging of their existing skills and interests. Authentic learning practices, like Project-Based, Community-Based, and Work-Based Learning, make such changes by orienting instruction around topics relevant to students' experiences and allowing students to practice their knowledge in real-world settings. Schools can encourage the adoption of authentic learning by implementing a complementary practice like portfolios. Local successes in schools using authentic learning and portfolios separately demonstrate their joint viability, but a system that combines the practices and can scale nationally has yet to be discovered.

Using the local "existence proofs" as starting points, I developed a system architecture that addresses many known barriers to adoption, including the time/resource constraints of schools, colleges, employers and the inequitable access some students have to engaging learning experiences. This initial proposal did not, however, address constraints imposed by schools' accountability obligations nor stakeholders' uncertainty over their peers' readiness to adopt the system. By investigating how federal and state policies have enacted similar transformations, I determined that authentic learning portfolios will likely require government mandates. These mandates could face pushback, however, from families concerned that the proposal would hurt their student's college options. I also interviewed colleges to establish what changes to the proposal were needed to ensure their support and thus satisfy parents' concerns. My findings helped refine the proposed system architecture as well as outline the next steps needed to successfully implement the proposal.

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Chapter 1

Introduction

1.1 Education's Need for Transformation

Education systems play a critical role in sustaining a society by equipping citizens with the abilities and mindsets necessary for personal and professional success. Quality schooling increases an individual's economic standing, civic participation, and standard of living (OECD, 2019, 2022). While typically conversations around education reform focus on skill development, the importance of socializing students to work better with their peers and understand cultural norms should not be minimized. An effective education system successfully develops both a student's cognitive[1] and non-cognitive[2] qualities. While a student's cognitive development prepares them with the knowledge and skills necessary to understand a situation and solve associated problems, their equally important non-cognitive development helps them do these tasks most effectively. Without qualities like self-discipline, meta-cognition, communication, and cooperation, students would struggle to take the theoretical knowledge they hold and apply it to the more nuanced problems they face outside the classroom (Bjorklund-Young, 2016). Success, both professionally and personally, depends

[1] "the skills involved in performing the tasks associated with perception, learning, memory, understanding, awareness, reasoning, judgment, intuition, and language" ("Cognitive Ability", n.d.)

[2] "patterns of thought, feelings, and behavior" that shape how an individual approaches a new situation (Borghans et al., 2008)

on these so-called "soft skills," and a school system unable to adapt to the times to facilitate their development will ultimately fail its students.

American K12 education has unfortunately not kept pace with the needs of the 21st century. The current system still reflects the needs of a more industrial economy in which students could easily find meaningful employment with a high school diploma (Rose, 2012; Schrager, 2018; "U.S. Education", 2020). Schools could focus on rote learning to reinforce the cognitive skills a student would need to work on the assembly line. Some students would pursue higher education to advance their career, yet again much of their development responded directly to needs of a growing economy. America has since changed, and the current needs of society can longer be addressed by the outdated system. The economy has shifted away from manufacturing towards services, and as a result, an individual's communication and interpersonal skills hold greater weight during their job search (Spar et al., 2018). People more connected through technology to their global peers than ever before in human history, thus requiring young adults to rely more on their non-cognitive qualifications to differentiate themselves in the competition for limited college and career opportunities (OECD, 2022). The United States has long faced these challenges, yet recent events have made change even more necessary.

The COVID-19 pandemic has not only amplified the challenges faced by American schools but also has created the unique opportunity for the system to make meaningful reforms. School closings and disruption of normal services have effectively eliminated pre-pandemic gains in reading and math achievement (Mahnken, 2022). Absenteeism soared during remote classes, and for many districts, students have yet to return fully (Mehta, 2023). While some measures like college enrollment have begun returning to normal, the impacts to all ages of students will continue to have ripple effects for decades to come ("COVID-19", 2022). Some of the most obvious ripple effects have occurred on college campuses where professors note their incoming classes lack many of the basic skills that they need to succeed in their introductory level courses (Fawcett, 2022). With the many challenges that schools have faced in the past not being brought into the national spotlight, policymakers and private organizations

have readied themselves to make needed investments to reform the system. Through the Elementary and Secondary School Emergency Relief Fund, nearly $200 billion in federal funds have been set aside to help school districts implement learning recovery programs ("Elementary and Secondary School Emergency Relief Fund", n.d.; Horn, 2022). As one of the largest influxes of money into education in recent years, schools can now make needed changes to their status quo.

The non-adaptive K12 education system requires more than simple fixes though to respond to its problems, and without broad systemic changes, many students will continue to struggle. Traditional practices, such as high-impact tutoring in response to learning loss, have made up much of ESSER funds' use yet do not support students that already trailed behind their peers equitably (Horn, 2022; Kane, 2022). Students at the low end of the achievement gap prior to the pandemic must now also overcome the learning loss caused by shutdowns, and thus, basic interventions must work significantly more to make an impact. Systemic changes, however, address the root causes of learning gaps rather than just patching them up to create short-term successes. The reforms needed to the systems are frequently costly, yet ESSER funds create a once-in-a-generation moment to start necessary work (Horn, 2022; Kane, 2022). As funding and time will still be limited, the first step should then be identifying the features of the systems through which reforms can make the largest improvements.

1.2 The Case for Student Engagement

Student engagement, or rather the lack thereof, has contributed to many of the challenges faced by American schools. Engagement can comprise many aspects of the student's learning experience, but for the purposes of this thesis, it will describe the student's attention and interest in the material taught in their school. Highly engaged students often find motivation to pursue the material further, may conduct their own independent exploration of the subject, and can often connect coursework to their personal lives ("Student Engagement", 2013). Conversely, disengaged students do not see the relevance of the material being taught and thus will make minimal effort both

in and out of the classroom.

Transforming how the education system approaches engagement can make classrooms more responsive to contemporary needs, community context, and students' existing strengths. Engaged students often contribute more to class discussions and can use their personal voice to shape lesson plans to consider these perspectives (Conner et al., 2022). By considering the contemporary context to topics, students can find their learning more relevant to their lives. Likewise, viewing learning through the perspective of their community further connects subject material to situations they are familiar with. Research has, for example, found that including a community context to a subject like math can better engage Black male students by helping them visualize how the content relates to the problems they see in their neighborhoods (McGee and Pearman, 2015). Finally, engaged students typically feel more comfortable leveraging their strengths and asking for help with their weaknesses. Engagement builds a sense of optimism around learning which encourages students to try new things with less fear of failing (Medlin and Smith, 2011). Rather than shy away from challenges, engaged students take them head on and learn more as a result.

Research supports the case for engagement, yet other measures like achievement as determined by test performance often take precedence in reforms. The system often chooses test-based achievement out of convenience; standardized tests provide a seemingly easy and replicable way to record a student's cognitive development. Agencies may find it harder to quantify engagement and its impacts beyond test scores, so they shy away from orienting their efforts around it because success will be harder to demonstrate (Fredricks et al., 2011). Stakeholders like colleges further maintain the status quo by integrating achievement measures into their own processes. With many colleges historically requiring tests like the SAT and ACT for admissions, states have designed high school accountability systems around the tests (Klein, 2018). The noble rationale for the choice was to remove barriers to college by offering them a free test registration, yet colleges' endorsement of test-based achievement discourages schools from considering more radical approaches. Even though policies like the Every Student Succeeds Act grants states more autonomy over the tests and practices they

use for accountability, the current landscape has continued to constrain creativity and thus further ignore engagement (Gewertz, 2018). Stakeholders within the educational ecosystem as well as those who support it externally must play a role in designing system-wide changes. The difficult question remains though: what practices should be given the chance to change the system for good?

1.3 Exploring Portfolios and Authentic Learning Artifacts

This thesis specifically considers authentic learning portfolios as a strong candidate for transforming K12 education to better engage students. My proposal combines two approaches with documented potential for improving student learning outcomes. Portfolios provide the proposed system with an infrastructure that facilitates the needs of complementary practices. For the purposes of this paper, ***an educational portfolio*** consists of:

- Artifacts of student's learning, created originally for a more immediate purpose (i.e. class assignment, extracurricular competition)
- Reflections by the student, written to provide context on how artifacts connect to the student's learning and future goals
- Feedback from trusted adults (i.e. teachers, supervisors, mentors), oriented to evaluate student's current abilities and provide direction for further improvement

Historically, individuals have collected physical copies of artifacts, yet with the modern growth of information technology, many individuals choose to construct digital ePortfolios instead due to their greater flexibility in construction and ease in distributing. Regardless of form, an individual's portfolio can serve multiple purposes; in talent development and hiring, for example, the common purposes of portfolios include "the development, the assessment, and the documentation of qualities"

(Strohmeier, 2010). An individual can design a portfolio to fit a narrow purpose, yet more often, they choose to create one master portfolio containing all artifacts and tailor sub-portfolios from it as needed.

Portfolios can support the adoption of more authentic learning practices in schools, centering student engagement as a central goal of the education system. I define for this thesis ***authentic learning*** as educational practices that account for a student's existing knowledge and make deliberate attempts to connect subject matter to a student's interests (Donovan et al., 1999); this contrasts with more artificial instructional practices like multiple-choice tests and worksheets which often present a one-size-fits-all approach to teaching and fail to demonstrate the relevance material has to the students' lives. Specific examples included in this paper's definition include

- **Project-Based Learning:** practices which orient learning outside of individual assignments, requiring a longer time commitment and generally offering students autonomy in what their outcomes look like
- **Community-Based Learning:** practices which orient learning within a physical community outside the classroom, such as the school, town, or region
- **Work-Based Learning:** practices that orient learning in a professional environment, often having students with a local company or organization in an internship or work-study capacity

These practices need not exist in vacuums, and often work best in conjunction with one another. For example, combining Project- and Community- Based Learning has helped the Cabot School in Vermont foster a learning environment that encourages students to identify problems from their community and develop ways using their abilities to address them; past projects ranged from exploring how New England nature has impacted American literature to investigating challenges faced by the community's watershed ("Cabot Projects | High-Quality Project-Based Learning", n.d.). Literature also supports that combining Community-Based principles with other approaches can better engage underserved students by connecting learning to

the challenges they face daily (Martin and Fisher-Ari, 2021; McGee and Pearman, 2015).

Authentic learning artifact portfolios are chosen here as a preferred approach to changing the education system as they have unique potential to address the diverse needs of educational stakeholders. Stakeholders within the US educational system range from K12 schools tasked with providing the education, to higher education institutions and employers that then admit or hire students with the necessary skills, to government and non-profit agencies evaluating and regulating the efficacy of schools, to parents and students themselves who have their own influence on the other groups in the system. Authentic learning artifact portfolios transcend stakeholders' diverse requirements and goals by interacting with the common themes that tie them together: evaluation and assessment. While student learning remains the goal for all the stakeholders, addressing evaluation and assessment through system changes could offer the most inertia for change due to how these processes inform instruction (Biggs, 1999). By designing authentic learning portfolios to address the evaluation and assessment needs of the stakeholders, the system needed inertia to encourage the complementary innovations to be implemented.

Despite the early evidence and arguments in favor of portfolios and authentic learning, the education landscape has been slow to widely consider the practices for various operational reasons. Operationally, both practices pose challenges to an already resource-challenged system; in one model, it is estimated the US underfunds its public schools by roughly $150 billion ("Closing America's Education Funding Gaps", 2020). Once adopted, stakeholders may continue to face challenges due to the time required to adequately prepare and evaluate artifacts. Within high schools, counselors often have an overwhelming caseload that prevents them from giving the individual attention to students that they would need while putting together their portfolios ("School Counselors Matter", 2019). Stakeholders receiving portfolios will also face challenges due to time as many colleges currently must spend less than 10 minutes reviewing admissions applications (Korn, 2018); hiring managers face their average review time of less than 8 seconds per resume, again not enough to

appropriately review a compelling portfolio (O'Donnell, 2018).

Beyond the operational challenges, which can be addressed through the system architecture, the perceptions stakeholders have of each other also impact the viability of implementing the practices. Authentic learning portfolios would signal a substantial departure from convention in the educational landscape, but many entities have hesitated to become the first mover in the transition. This hesitancy has not stopped entities from signaling their support for the changes; for example, the Mastery Transcript Consortium secured the support of 160 higher education institutions for their alternative transcript that feature components of portfolios and authentic learning (Montes, 2021). These supporters, however, have yet to initiate a complete adoption of the practice out of concern other stakeholders could not play their role effectively or that the transition would affect their standing among their peers. Many of these perceptions have not been explored in the literature fully, hence the need for this research into how cooperation can be achieved to promote adoption of an authentic learning portfolio system.

1.4 Thesis Overview

This thesis aims to propose a comprehensive system design for using authentic learning portfolios across K-12 and Higher Education. In preparing the operational details for this system design, I also considered the following research questions:

- *What features lead to a successful implementation of an authentic learning artifact portfolio in K12 learning and higher education admissions?*
- *What are the actual and perceived restrictions that have prevented wide adoption of authentic learning artifact portfolios?*
- *What next steps can stakeholders take to foster a landscape that encourages portfolios?*

The remainder of this thesis is organized as follows. Chapter 2 expands on my definitions of authentic learning and portfolios and provides examples of how each

are currently implemented inside and outside of schools. Chapter 3 then introduces an initial attempt at a system design for authentic learning portfolios. Chapter 4 identifies the current barriers that have constrained wide adoption of authentic learning approaches. Chapter 5 explores, through an analysis of the enactments of two similar transformations, how policy could support the adoption of authentic learning portfolios. Chapter 6 presents findings from interviews with college admissions representatives regarding their perspectives on using portfolios in their processes. Chapter 7 then concludes by discussing the broader implications of this research on designing education transformations and proposes a final system design and action plan for using authentic learning artifacts in education.

Chapter 2

Authentic Learning and Portfolios: Better Together

Schools could equally benefit from implementing authentic learning and portfolios individually, but the two practices make the largest impact when implemented in coordination with each other. In this chapter, I expand the definitions of authentic learning and portfolios by identifying existence proofs of the practices. Existence proofs here demonstrate successful implementations of the practices in individual local settings. I include existence proofs from within education as well as some examples of practices' use outside the classroom when adoption by schools have remained limited. Using a variety of existence proofs, I then explain why a combination of authentic learning and portfolios has the most potential to facilitate more student engagement.

2.1 Authentic Learning

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Authentic learning, again, consists of instructional practices that intentionally connect course material to topics and issues meaningful to students ("Authentic Learning", 2013). One can also determine the authenticity of a learning practice by considering how much focus the approach affords to using knowledge rather than just

retaining it. Where a traditional assignment typically requires students to remember exact details such as formulas or definitions when prompted, an authentic learning assignment depends less on finding the right process or result and instead prioritizes the thinking a student puts into setting up their approach. Authentic learning closely resembles the activities a student can expect to encounter outside the classroom; unlike in traditional assignments, students in the real world will have flexibility in how they approach problems and will often have the chance to try again when they fail. Authentic learning encompasses a range of practices rather than one single approach. The following sections describe some of the most prominent examples of authentic learning currently in schools.

2.1.1 Project-Based Learning

Of all the instructional practices considered authentic learning, project-based learning has gained the most traction in schools. In its simplest form, PBL uses projects completed over a significant period of time that require students to apply existing knowledge. Projects often involve complex thinking and typically have no singular correct way to complete. Besides exposing new ways to understand course material, PBL also emphasizes the development of non-cognitive skills since students must take more responsibility for their own learning (Shanbhag et al., 2020). PBL as a term can sometimes be misappropriated to describe assignments that do not fit into the other categories like tests or essays; these wrongly categorized projects, however, do not meet my definition of authentic learning as the strict directions that usually accompany them limit student's ability to tailor an assignment to their personal interests. Likewise, the structure of a project ultimately indicates whether we can rightfully consider it as PBL; ideally, students should have an active role in defining their problem of interest in PBL, and teachers should restrict their involvement to advising students as needed. With this stricter definition of PBL, we can identify more useful existence proofs of the practice.

With the growing interest in project-based learning in past decades, system-level efforts have developed to ensure that schools have resources available to support their

implementations. PBLWorks has had some of the largest impact in assisting schools with their PBL programs. Founded in 1999, PBLWorks has produced research and training materials to aid teachers in creating sustainable, high-impact PBL experiences in their classes ("About PBLWorks", n.d.). Beyond direct support of teachers, PBLWorks has also proven the efficacy of PBL through its collaboration with large educational providers like the College Board. Seeing the rising momentum PBL has in education, the College Board wanted to learn how they could best integrate the practice into their products. PBLWorks helped them develop training for integrating PBL into the Advanced Placement programs. Currently, the College Board only provides official guidance on projects in the US Government and Politics and Environmental Science courses (Saavedra et al., 2021). Independent efforts, however, have also considered how PBL can fit into the other course offerings, with one article providing advice on how to set up a project that works well with the AP Psychology curriculum (Kuykendall, 2022). PBL has also become more prevalent among Open Educational Resources. The MIT BLOSSOMS project, which makes high quality video lessons openly available to teachers globally, embraced the PBL approach in its newest resources; their PBL materials complement some of their existing lesson plans and provide instructors guidance on how to structure projects so students can fully engage (Cammarata and Larson, 2018). As more providers consider how PBL could fit into their offerings, schools will find the practice easier to adopt.

2.1.2 Community-Based Learning

Community-based learning takes inspiration from PBL yet instead orients projects towards problems in the communities that represent the students. The definition of community here can be broad; students may choose to explore problems in their school, neighborhood, town, state, or even country or world. Regardless of the project location though, the practice engages students in authentic learning through deliberate connection to their daily lives. Related to community-based learning is service learning; they share a similar motivation of situating learning in scenarios where students address problems affecting their community. Community-based learning has

uniquely shown strength in engaging underserved students in their courses; one study on the math achievement of Black male students revealed that students who were taught explicitly how the subject could help them improve their communities later performed better in the subject (McGee and Pearman, 2015). Focus groups with students have further supported community-based learning's unique ability to engage students, with participants repeatedly identifying giving back to their community as a priority in their lives (Martin and Fisher-Ari, 2021). Classrooms that can leverage this passion for community in lessons have an easy route to creating authentic learning experiences.

MIT BLOSSOMS provides a good example of the community and service focused learning described in the Flaws of Averages unit ("Flaws of Averages | MIT BLOSSOMS", n.d.). Students learn how averages can mislead the community's understanding of problems by developing projects related to community safety issues. After collecting data in their community about their problem, students return to the classroom to apply their statistical knowledge. At the end of the project, they present their findings and recommendations to community leaders involved with their chosen problem. Through this project, students of course strengthen their quantitative abilities, but more importantly, they can practice non-cognitive skills related to collaboration and professional communication. The importance of their projects to their communities means students have a more vested interest in its outcomes than the typical project.

MIT BLOSSOM's community safety project reflects a common approach many community organizations have started to apply to their youth development programs. La Colaborativa, a community organization focused on uplifting the Latine community of Chelsea, MA and greater Boston, has overseen numerous youth-led projects to improve their neighbors' quality of life ("About La Colaborativa", n.d.). Past youth advocacy work fostered by the organization includes organizing initiatives that promote fair housing and vaccination during the pandemic, speaking with lawmakers about the challenges facing their peers, and collecting data to inform community decision-making. In one project that could easily fit into MIT BLOSSOM's

Flaws of Averages lesson plan, students in La Colaborativa's STEM internship program analyzed residents' use of a busy set of intersections and worked with their city politicians to recommend ways the streets could be improved to reduce congestion, increase pedestrian safety, and decrease air pollution ("Construction Updates", 2022). La Colaborativa illustrates one local success of putting students' learning to work on problems meaningful to their lives rather than on inauthentic ones presented on a worksheet.

2.1.3 Work-Based Learning

Work-based learning serves as my last example of authentic learning. While not novel in the scope of an individual's preparation for a career, internships and other forms of work study have gradually entered K-12 education to engage students. In a work placement, students begin to experience how they will translate their knowledge to their careers after they receive their diploma. Often, work-based learning will place students in jobs not normally associated with the average high school student. Rather than the part time restaurant job or seasonal gig during school breaks, a strong work-based learning program places students in positions that relate to their long-term goals. A future STEM professional, for example, could be placed with an engineer to help with drafting. Future medical professionals may instead find opportunities working alongside doctors and nurses in a clinic to develop their skills. These experiences tie together the two main components of authentic learning: real-life uses of knowledge and practice of non-cognitive skills. With a job that interests them, students will make connections with their learning currently absent in most classrooms. Their placement will also expose them to the norms of their future profession and help them visualize themselves in the field. The visualization that a student experiences in their placement can significantly increase a student's engagement in the classroom, with research showing that students feel more motivation to learn when they feel that they can reasonably achieve the goals they set for themselves (Dotson, 2016; Martin and Fisher-Ari, 2021). Work-based learning, however, can pose difficulties in implementing. Schools would need to develop connections with corporate partners and make

sure they can offer high quality experiences to students. Class schedules would likely need adjusting to allow for students to work on-site at their placements. Like most authentic learning approaches, schools will likely need system-level changes first.

The existence proof for work-based learning comes from the Cristo Rey network of schools. Consisting of 38 private schools across 24 states insert citation, the Cristo Rey model emphasizes career readiness through its four-year corporate work study program ("Results", n.d.). All students that attend a Cristo Rey school get placed in a position with one of their many corporate partners. Job responsibilities have included research, communications, data collection, and process management, a variety that allows students to find a position that fits their interests and goals. For more realistic working experiences, students spend 5 full days a month in their placement; to facilitate this, the schools have adopted a shortened four-day class week, leaving the fifth day open for students to work with their partner. Mentorship also plays a key role in Cristo Rey's success; students have an adult contact with the corporate partner available to them throughout their placement, whether it be for job-specific questions or for more general inquiries related to the student's future career decisions. Cristo Rey students come from limited income upbringings, and the work study financially supports them, so they do not have to pay tuition. The school network has also demonstrated impressive results in improving their students' high school outcomes. In their Boston school, they consistently graduate 100% of their senior class each year. Across the network students are also more likely to enroll (85%) and complete college (39%) than their similarly situated peers (48% and 15% respectively) ("Results", n.d.). Cristo Rey's spread across the country has helped them refine key systems like the corporate work study program, creating a good model for other schools to consider as they develop their own approaches to work-based learning.

2.2 Performance Assessment

Many more forms of authentic learning exist, and among those as well as the previously identified examples, the practices often rely on some form of performance

assessment. Whereas traditional assessments involve students recalling content they retained in response to set questions, performance assessment instead has students exhibit their skills via evidence they collect from a task they completed (Guha et al., 2018). Naturally, performance assessment synergizes well with authentic learning that situates instruction within real-world contexts. Performance assessment also frequently occurs as formative assessments. In contrast to summative assessments that occur at the end of a unit or term and cover all material taught in the time frame, formative assessments instead occur at more frequent intervals so that students can better judge their comprehension of material as they learn it ("Formative vs Summative Assessment - Eberly Center - Carnegie Mellon University", n.d.). With authentic learning covering topics over longer periods of time, formative performance assessments become critical for teachers needing to determine what areas students require additional support with. The value of performance assessment goes beyond the classroom as well, with many colleges and universities not considering how they could use the practice to assess a student's preparedness for advanced study. The Learning Policy Institute has made many of the advancements in establishing standards colleges could use for accepting performance assessments, and their work has secured commitments from many colleges to explore the future of the practice (Guha et al., 2018). CRESST at the University of California Los Angeles has made similar pushes for performance assessment, working with the UC admissions teams to develop a possible replacement for standardized tests as the university system chose to remove test scores from future application cycles ("CRESST Recommendation for New Assessment System for UC Admissions", 2020). Authentic learning will require massive changes across the education system to remain sustainable, allowing other practices like performance assessment to flourish.

2.3 Portfolios

The portfolios of interest to this thesis go beyond the simple collection of a student's work samples. Portfolios often have multiple purposes which can take priority over

each other based on the current context. The most common purposes for portfolios in education are "the development, the assessment, and the documentation of qualifications" (Strohmeier, 2010):

- "Development-oriented portfolios" chronicle through time-sequenced artifacts the personal development of the author
- "Assessment-oriented portfolios" require a more discriminating selection of artifacts, highlighting those which best relate to specific learning objectives
- "Documentation-oriented portfolios" require discernment similar to that needed in "assessment-oriented portfolios" yet the author instead focuses on what artifacts exhibit qualities defined by a certain organization's objectives

Unlike authentic learning approaches which are still developing and have rarely operated at scale in larger school environments, portfolios have a lighter burden which has led to wider adoption across the education system. With some fields having long histories with using portfolios in learning, implementation has often relied on adapting the practices of one use to a new application. K-12 education has adopted portfolio approaches that found success in higher education, and higher education has used portfolios similar to those that graduates will experience in industry. Unfortunately, the implementation of portfolios can stay too shallow, focusing on simple storage of artifacts rather than true engagement of students. Portfolios must push students to dive deeper into learning through self-reflections and responses to feedback from teachers and mentors. This section explores the ways K12 and higher education as well as industry have expanded portfolios beyond a simple collection of artifacts; my purpose here is to highlight the key features that led to the success of these portfolio interpretations.

2.3.1 Existing Uses in K12 Education

Due to the simplicity of the practices, many schools have already implemented portfolios in some form. By definition, any collection of artifacts a student makes for

class would comprise a portfolio. These simple portfolios, however, lack many of the features that would encourage more opportunities for authentic learning. The portfolios of true interest for developing this thesis are those where construction becomes part of the curriculum. Rather than using them simply as a place for storage, teachers that involve students' portfolios in instruction can maintain their students' engagement by discussing the relationships between current course material and their past experiences. Even the most involved uses of portfolios in the classroom can fall short though if the curriculum supporting them does not assist students with creating rich artifacts to collect. Exemplary use of portfolios can only be identified in conjunction with other effective practices, in this case authentic learning practices. The remainder of this section highlights some existing uses of portfolios in specific schools and throughout larger networks that exhibit the relationship between portfolios and authentic learning practices.

Envision Learning Partners (ELP) exemplify a school system that has implemented portfolios as a core educational practice. Comprising of schools across the US, ELP has embraced portfolios as part of their commitment to integrating performance assessment into instruction ("Portfolio Defense", 2021). Portfolios facilitate the process by creating a structure to retain artifacts and guide student reflection. Students use their portfolio as a guide for their learning during their schooling and as proof of their qualifications during their post-K12 pursuits. Unlike a written reflection, students capture the connections between their artifacts and their personal motivations through their presentation. Repeating this defense annually creates a chronicle of their development, and a student can exhibit how they have grown between defenses. Verbal reflections not only strengthen a student's communication skills, yet also may make learning more accessible to individuals who may at first struggle communicating their experiences in a written format (Huxham et al., 2012). The success of ELP's portfolio-defense approach would not be possible without the many authentic learning experiences students have access to at an Envision school; with the opportunity to complete work-based learning experiences and various performance assessments during their education, students will have a plethora of rich

artifacts they can describe during their defense ("Our Approach", n.d.). The ELP model has shown success in various communities, and with proper attention, their approach can help inspire needed systemic change to the education system.

At a system level, the Mastery Transcript Consortium has also demonstrated the value of connecting student abilities to evidential artifacts for improving student outcomes. The Mastery Transcript focus on a student's competencies over the courses they took and the grades they received ("Mastery Transcript® and MTC Learning Record", 2019). Schools select the competencies they believe all graduates must minimally demonstrate. Students receive credits for these competencies by demonstrating their proficiency inside and outside of class. The student can also highlight artifacts representing their proficiency on their final transcript. The Mastery Transcript appears most similar to portfolios through this feature, as the transcript also becomes a collection of work samples the student can share with interested parties. When the student, for example, sends their Mastery Transcript with their college application, their admissions counselor can now see real-world examples of the competencies they purport to have. While radically different from the conventional transcripts, many colleges have openly expressed their cooperation with the Mastery Transcript, expressing that students attending consortium schools will face no detriment compared to their peers (Montes, 2021). Again, the success of this portfolio interpretation depends on the quality of experiences a student accesses; multiple choice tests, while evidence of a student's competencies, provide less depth than authentic learning artifacts. The Mastery Transcript, like other portfolios, has shown, however, to be a good incentive for schools to integrate more authentic learning into the curriculum.

Portfolios have also played a critical role in integrating authentic learning in the AP program as discussed earlier. AP Studio Art has the most obvious reason for the inclusion of a portfolio because of the subject's long use of portfolio reviews in its pedagogy (this history is discussed in further detail in later sections of this chapter). AP would later include a portfolio in their Computer Science Principles exam to allow students more autonomy in how they demonstrate their newly acquired programming knowledge; in this iteration of portfolios, students submit a long-term project of their

choice to be evaluated by their instructor against a common rubric (The College Board, 2018). Students have complete control over the scope, details, and technology used in the project, and many schools have integrated community- and work-based learning into their instruction for the class. The AP Capstone Diploma includes portfolios in its two-course sequence, AP Seminar and AP Research; students taking these courses complete individual and team research projects which they document through artifacts in their digital portfolio ("AP Capstone Diploma Program – AP Central | College Board", n.d.). Finally, AP collaborates with the WE Service program to add service-learning to other existing AP courses which they evaluate through a portfolio review. This community-based approach to authentic learning is documented by the student throughout the term and stored again in their digital portfolio for their instructor to verify (The College Board, 2020). AP's recent steps to integrate authentic learning into more of their offerings will likely continue to include portfolios as the practice works well with the performance assessment they would need to implement.

State governments have also taken action to encourage the creation of portfolios as part of a school's graduation requirements. Colorado, for example, has encouraged high schools to adopt proficiency-based practices like capstone projects and portfolios as part of their local graduation requirements. To support their schools that have chosen to adopt these practices as part of their local requirements, districts have developed their own "Profiles of Graduates" to guide students on what skills they need to develop to graduate (Spicer, 2019). Cañon City High School exemplifies such a graduate profile that has made education more engaging for students there (Quirk et al., 2020). Colorado's role in implementing portfolios in schools has remained advisory as they have yet to require the practice in all schools, but some states have taken action to ensure student's portfolios can be formally recognized. Through diploma seals, Ohio high school students can demonstrate their achievements beyond the minimum requirements ("Demonstrating Readiness | Graduation Seals", n.d.). Each diploma seal has its own set of standards to receive related to the nature of the seal. The "College-Ready" seal requires students to score high enough on either the ACT or SAT to place into college-level coursework, whereas the "Seal of Biliteracy"

requires demonstrating mastery of a language other than English on a standardized test. Not all seals depend on test scores though, with many seal requirements sharing features with portfolios. For the "OhioMeanJobs-Readiness" seal, students work with a mentor to select evidence of their behavior in and out of class that demonstrates their proficiency in 14 professional skills ("Demonstrating Readiness | Graduation Seals", n.d.). Many of Ohio's Honors Diploma seals also require students to collect evidence from a field experience in a portfolio as it relates to the topics that they are interested in. The flexibility allowed in the diploma seal's portfolio requirements means that students can select the experiences that most engage them rather than follow a one-size-fits-all pathway towards graduation. As will be discussed later in Chapter 5, policy action provides the most direct way to encourage schools to adopt the proposal, and with Colorado and Ohio leading in regard to portfolios, other states have strong foundations for their own system designs.

2.3.2 Existing Uses in Higher Education

Higher education has taken greater steps than K-12 education to implement systems that demonstrate the potential authentic learning portfolios have for education. Most efforts to integrate into the classroom practices like those required for authentic learning portfolios have occurred within disciplines that have historically invested in student's practical experience. Arts and design fields have long been closely associated with portfolios; the portfolio for an art student is not only an opportunity to develop their technical skills in a medium but also an exhibition of their unique point of view as well as their specific approach to the design process (Taylor, 2010). As a result, "portfolio literacy" has become a critical component of a student's education in many arts programs (Barnes et al., 2022).

Portfolios have also been used to support programs with many authentic learning experiences already present in their curricula. Certain service professions, namely nursing and teaching, use forms of workforce learning in their curricula to help prepare students for on-the-job responsibilities which require more than theoretical training. Clinical education for medical professionals and student teaching in education pro-

grams both exemplify rich authentic learning experiences which K-12 schools can use as inspiration for their own programming. In recent decades, portfolios have grown in popularity in these programs as a way to encourage further reflection on student's experiences. Teacher education programs have specifically found use of portfolios, with many programs highlighting how the practice has helped students better prepare for finding employment after graduation (Boody and Montecinos, 1997). The use of portfolios in teacher education makes sense since numerous studies have shown how the type of reflection fostered by portfolios can help new teachers better prepare for the challenges they will face in their early years in the profession (Shandomo, 2010). While not all fields can support the level of authentic learning that occurs in these professional programs, other programs would likely still benefit from adopting pedagogy that encourages students to reflect on how course content connects to the real-world situations they may encounter after graduation.

Higher education institutions have also experimented with using portfolios beyond the lecture halls as part of their admission processes. Due to their history of using portfolio-like practices in the classroom, art, design, architecture, and performing arts programs typically require a portfolio exhibiting a student's artistic ability in their application. The artifacts provided by a student often supplant their grades and test scores, yet some institutions still may require an assessment of minimum academic ability due to the rigor of their general education requirements (Hoover, 2015; O'Donoghue, 2011). Design programs, specifically architecture, look at a student's artifacts to understand the applicant's design processes and unique aesthetics, something other programs like engineering may want to replicate (Limpatoudis, 2020). Whereas the other programs experienced with portfolio use in the classroom mentioned previously (nursing and teaching) have yet to require a portfolio in their applications, a portfolio could help prospective students exhibit qualifications uniquely required by their program. By considering how portfolios can help select applicants well-suited for their rigorous authentic learning environment, these programs can further improve their approaches to admissions.

Colleges of all types often use major-related interests to make the final decision

between similarly exemplary students, yet unfortunately, current applications fall short of allowing students to demonstrate the breadth and depth of their interest. While a student could list their work and extracurricular activities that relate to their field of study, the nuances of their experience may be lost if they fail to provide sufficient detail or expand on their experiences in their personal statement. Some colleges recognize this shortcoming and try to overcome it by accepting a student's supplementary materials. Supplemental materials often accepted include artistic or performance-related artifacts a student may have otherwise included in their portfolio to an arts program. Highly competitive colleges like Harvard also encourage students to provide any creative writing selections or research publications an applicant feels provide context to their application ("Application Requirements", n.d.). MIT in 2015 advanced their supplementary material section to better reflect the technical interests of their students by introducing the "maker portfolio" as a place for students "to showcase their projects that require creative insight, technical skill, and a hands-on approach to learning by doing" ("Creative portfolios", n.d.). Other schools, including Washington University in St. Louis and Tufts University, have followed MIT's example to offer similar avenues for students to demonstrate their technical abilities in pursuit of admission to their engineering programs ("Portfolio Reviews - Undergraduate Admissions | Washington University in St. Louis", n.d.; "School of Engineering", n.d.). University of Michigan has advanced their definition of supplemental materials to support the unique needs of its business school; by requiring students interested in direct admission to the undergraduate business degree to submit a reflection on a business case as well as an artifact that connects the applicant's learning to their life, the Ross School of Business has found a new way to benefit applicants to benefit students that go above and beyond to demonstrate their interest in the highly competitive field (Rideout, 2022; Willis and Martinez, 2023). Despite these successes in using the preferred practices of this thesis to support institutional goals, the existing uses described above also reveal challenges that an authentic learning portfolio system in K-12 education will still need to overcome.

The primary challenge for colleges interested in using authentic learning and port-

folios remains that these practices are hard to operate at scale. While authentic learning and portfolios greatly benefit some post-secondary curricula, these programs also often operate with small class sizes and high direct attention from instructors to achieve their success. Many K-12 environments face resource constraints and difficulties recruiting teachers that would hinder their ability to implement programs like the existence proofs identified above. Schools would need the flexibility to adapt the practice to work best in their environment. The scalability of portfolios poses the largest challenge of integrating portfolios more widely in the system. Few schools have adopted the practice, meaning many colleges would still need to develop in their processes before they would feel comfortable adopting portfolios as a requirement. Schools that have experimented with portfolios would also need to develop their capacity to review portfolios efficiently; with portfolio leader MIT only receiving maker portfolios from less than 10% of applicants in recent years, their current faculty-driven review process would likely struggle with providing timely reviews for a full applicant pool of more than 33,000 (Peterson and Abelson, 2015). One final concern based on higher education's experiences lies in whether all students would have an equitable opportunity to put a competitive portfolio together if they were used at scale. The current uses of portfolios depend on students having access to experiences that produce artifacts that college admissions readers will find compelling.

2.3.3 Existing Uses in Workforce

The use of portfolios by industry, another stakeholder group important to education reforms, can also help define the goals and challenges affecting the implementation of educational portfolios. In general, industry has used portfolios to evaluate candidates for hire, with their implementations most closely resembling Strohmeier's assessment- and documentation-centered portfolios described ealier (Strohmeier, 2010); these professional portfolios consist of artifacts chosen by applicant to indicate their proficiency in skills required for a position as well as exhibit their possession of other posted qualifications. Portfolios can stand by themselves in the hiring process, yet more often, they serve as a support to one's interviews or as a part of the hiring manager's re-

view of past work. Portfolios offer applicants an efficient way to collect, organize, and distribute this information to hiring managers. Hiring managers, in turn, have shown their support towards the practice. In one recent study, 75% of respondents involved with hiring decisions found portfolios as potentially useful (Holtzman et al., 2021). Growing use of portfolios for talent development and recruiting supports the practice's possible usefulness for K-12 instruction and assessment.

Though portfolios have shown great potential to support hiring, use remains limited to select fields. Ambivalence towards the practice by some recruiters explains some of the practice's restrained use as recruiters have limited incentive to transition unless portfolios can fulfill specific organizational needs (Strohmeier, 2010). Portfolios may also face implementation difficulties in fields that do not already rely on using work samples and other authentic demonstrations of qualities in their hiring processes. This latter explanation of portfolio's still limited use in industry is supported by the sectors that have shown favorability toward them; surveys have shown that the art, design, engineering, and human service sectors have all demonstrated more favorable views towards using portfolios in hiring (Holtzman et al., 2021). Regardless of the reason for the limited use, portfolios in the workforce have generally succeeded when specific standards could be established for what a portfolio should consist of, something that has been easier for some positions than others. K-12 education has similarly struggled with identifying standards that reflect society's differing views of the purpose of education and what skills and qualities should be prioritized. With the most successful implementations of portfolios considering the needs of the organizations that will eventually review them, cooperation between industry and education can lead to standards that benefit all stakeholders (Ward and Moser, 2008). The remainder of this chapter explores how the sectors most supportive of portfolios, specifically art and design, software engineering, and human services, approach using portfolios to achieve their unique requirements.

Art and Design

Art and design portfolios have a long history in supporting hiring decisions. The previously mentioned push for "portfolio literacy" in fact came out of a necessity to prepare young artists for professional advancement highly dependent on the quality of their portfolios (Barnes et al., 2022). Portfolios primarily support hiring for positions in arts and design by exhibiting an individual's technical abilities, either in a specific artistic form or in the tools required by the discipline (Taylor, 2010). Secondarily yet not less in importance, the art portfolio also captures the thinking an artist puts into all stages of the design process. This balance of exhibiting both cognitive and non-cognitive qualities in a portfolio will be critical for a system like the one to be proposed that intends to support authentic learning in the classroom. Of all the other sectors that have adopted portfolios, the art and design fields provide the richest examples for education to use as models for their own system as portfolios' long use in their hiring has allowed them to also be embedded deeply in their education programs. As mentioned prior, art teachers often use the same methods to evaluate a student's development-centered portfolio as their future supervisors will (Taylor, 2010). The only concern raised for artistic portfolios comes from the split focus between learning and presenting one's best self to future employers that often occurs during art education (*AIGA Designer 2025, Why Design Education Should Pay Attention to Trends.* 2017; Barnes et al., 2022; Davis, 2012; Harland, 2011; R. Kelly, 2018). The most compelling portfolios for education will show the totality of a student's development, including both their successes and failures. By embedding the practice into both learning and assessment though, a portfolio system could undermine the authentic learning it aims to foster by incentivizing students to pursue experiences that they perceive will improve their admissions or hiring odds. Looking back to the existing uses in education, the future system architecture must reprioritize the learning fostered by a portfolio over the incentives that evaluation of the portfolio will create.

Software Engineering

Portfolio use in software engineering offers an interpretation of the practice that could address many of the concerns raised by art portfolios. While Github and similar code repositories initially served the utilitarian purpose of maintaining a developer's work, they have recently been recontextualized by many companies as a documentation-centered portfolio. Since many companies already reviewed code samples to determine an applicant's fit for a position, requesting personal repositories already containing many viable samples seemed natural. Managers in software development specifically highlight the "tangible evidence of [an applicant] having done something substantial" as a primary reason they ask for a code repository (Weiss, 2018). Additionally, training on building a code repository already exists in software development education, albeit the training focuses more on the technicalities of the platform rather than the "portfolio literacy" developed in art programs. The most compelling reason, however, to use code repositories as inspiration for a future portfolio system in K12 education comes from the indirect way in which a code repository can capture a developer's non-cognitive qualities. A code repository often provides functionality far beyond the storage of artifacts; the platform will usually also track the history of changes to a user's work, indicate contributions to other organizations or individuals' projects, and allow for peers to provide feedback on an individual's projects. The savvy reviewer can use the abundance of metadata generated by a student's interaction with their repository to evaluate less tangible qualities of an applicant like their fit within a company culture or their ability to work on a fast-paced team (Marlow and Dabbish, 2013). To save on time, data aggregators can automate the process to reveal key insights about the repository, improving efficiency as well as making the process harder to manipulate by keeping historical records of changes (Sarma et al., 2016). By developing a system that records metadata useful to future evaluations, the future portfolio system can start to handle the incentives created by existing implementations.

Human Services

While the previous workforce examples cover many of the issues faced by existing uses of portfolios in education, they still fall short due to both sectors allowing for the creation of numerous physical artifacts which exhibit a student's cognitive and noncognitive qualities. Authentic learning practices do not always, however, inspire artifacts that perfectly capture both. For example, consider the artifacts generated by a student's work-based learning. Positions in technical fields such as engineering will likely generate numerous artifacts that exhibit quantitative skills and critical thinking, yet more service-centered positions like in healthcare or education may not offer similar opportunities. The artifacts generated in these types of positions (i.e. correspondences, presentations, worklogs) capture the student's qualities imperfectly and will likely require additional context to truly evaluate. Since the portfolio systems in the previously discussed sectors are unequipped to handle this shortcoming, additional examples must be sought out. Fortunately, the human services sector, namely teaching and nursing, have made their own interpretations of portfolios to use in hiring.

In recent years, principals have looked to portfolios as one way to predict how teacher candidates work when brought into the classroom. With teacher instructors already favoring the practice, preservice teachers can easily provide the collection to future employers to review (Whitworth et al., 2016). The teachers' collections consist of both in-class and real-world experiences and typically include lesson materials, support plans, observation materials, and positive interactions with students, parents, and colleagues (Whitworth et al., 2016). These artifacts often show how teachers will approach managing their classroom and preparing engaging lessons, thus principals often choose to have teachers highlight their most compelling artifacts during an interview or as part of a live simulation rather than review the portfolio in totality. By reviewing portfolios in this fashion, principals appear to find most value in the teacher's reflection on their development, a critical step in the creation of their portfolios with their teacher instructors (Whitworth et al., 2016). In one survey, prin-

cipals specifically noted that they found an applicant's reflection on artifacts in their portfolio particularly useful in interviews (D. Kelly and Hancock, 2018). Principals very often lack the time to conduct a thorough review of a portfolio, so by focusing on the teacher's reflections, they can identify the artifacts most critical to understanding an applicant's qualification out of the exhaustive collections they frequently receive (Theel and Tallerico, 2004; Whitworth et al., 2016). Encouraging reflection during portfolio creation appears then to be a critical component to a portfolio system when wanting to put artifacts in the context of the student's broader development.

Nursing has similarly adopted portfolios as an evidence-supported exhibition of an applicant's human-service related skills. Leading use for certifications, the United Kingdom, New Zealand, Australia, and Canada have implemented portfolios that include typical application materials like resumes and letters of recommendation along with artifacts from the student's clinical and scholarly experiences (Meister L et al., 2002). Nurses, like teachers, also include written reflections to provide a similar context to their experiences. These reflections again help hiring managers select the best candidates for their healthcare organization from pools of high achieving applicants with otherwise similar credentials (McMillan et al., 2014). Nursing portfolios though have gone even further than those used in other human service fields by considering artifacts as part of licensing and certification processes. The above-mentioned countries all use portfolios during certification, making artifact discernment and self-reflection essential to the pursuit of a nursing career (Meister L et al., 2002). Much of the review done by the hiring manager can then be focused on the unique attributes of an applicant's portfolio as the certifying body would have already confirmed the nurse's technical qualifications during their review. Using an independent organization to verify a student's cognitive abilities, much like a certifying board evaluates a nurse's professional abilities, would not be new to education as standardized tests like the SAT and ACT are de facto certifications of preparedness for college in many admissions processes. Similarly, AP and IB provide an independent verification of a student's understanding of a college-level curriculum. With the organizations behind these tests experimenting with how portfolios could support their processes, the nurs-

ing portfolio offers a reasonable model for a portfolio in K-12 education that supports a standardized review process.

Lessons from Existing Uses

In looking at the existing uses of portfolios both in and out of education, a common conflict between a portfolio's different goals materializes. Specifically, the learning facilitated by portfolios diminishes when students manipulate their submissions to perform better in assessments or evaluations. Portfolios, however, do not struggle in this conflict alone, as concern over this manipulation affects almost all social indicators; Campbell's Law provides a formal definition for this widely prevalent struggle (Campbell, 1979). Highly visible examples of Campbell's law have occurred in education in recent years, the greatest of which being Operation Varsity Blues exposing private college counselor actions to manipulate transcripts, test scores, and activity records to secure college admission (Kasakove, 2021). Addressing this conflict in the proposed portfolio system poses no easy task, yet evaluation regimes that support learning rather than oppose exist.

Evaluating non-cognitive qualities after establishing minimum cognitive competency offers one way of discouraging manipulation. As seen in the nursing portfolios, once a body certifies a candidate's minimum qualifications, hiring managers have freedom to differentiate candidates based on their unique attributes. Unlike standardized tests which often have scores higher than what they deem proficient, applicants differentiated themselves based on their non-cognitive qualities rather than the arbitrary differences between their scores. The different implementations of the portfolio also show that the presentation of non-cognitive qualities can be harder to manipulate when the platform requires the student to exhibit the quality consistently over their submissions. Consider the data aggregators of coding repositories; a candidate demonstrates qualities like collaboration and perseverance through the history of their contributions, something not easily replicated by a candidate seeking to artificially craft their portfolio to manipulate the system. Not all aspects of a portfolio can resist manipulation; for example, a student could try to go back and

change their reflections to exhibit a quality they did not develop until later in their academic career. A process that rewards going beyond the minimum, however, could discourage such attempts at manipulation and push students to engage learning with their unique interests.

Success of the proposed portfolio system will also depend on defining construction standards relevant to the specific contexts it will be used in. Each of the workforce examples considered followed certain expectations from the sectors. These standards, while adhering to similar themes, differ vastly between disciplines; art and design portfolios need to document an individual's mastery of forms and their unique aesthetics, whereas software portfolios emphasize adherence to industry standards and best practices over creativity. Education portfolios instead will need to support learning and self-reflection when used in the classroom and exhibition of qualifications when used in a job or college application. Professional portfolios also demonstrate an applicant's passion for the field they work in. When constructing their portfolio, a professional will have numerous artifacts relevant to their specific field, and their reviewer will likely have the needed background knowledge to evaluate its merits. Students still early in their development will unfortunately lack this specificity when constructing their portfolios. As a result, evaluators will need flexibility to handle the diversity of artifacts they will receive. Standards will need to still establish a definition of minimum competency, yet they cannot restrict students so much that they again focus on the conditions of their evaluation more than their personal learning. Additionally, students will have artifacts shaped by their specific learning environment, and evaluators will need ways to compare students on the qualities of the student rather than the quality of the experiences. A student in a city or suburb, for example, may have more access to formal opportunities through colleges or corporations, whereas a rural student may instead have to rely on local business or their own ingenuity to supplement their learning. The education portfolio will need to allow for both the career-focused and the undecided student to succeed, regardless of the capacity of their school and community.

Finally, the existing uses of portfolios further demonstrate the time and resource

barriers many organizations will face trying to review submissions. In each application discussed above, organizations found ways to simplify portfolios to allow for a more efficient review. The existing K-12 uses succeeded since reviews occurred among smaller batches of portfolios, either at a classroom level for reviews of specific course knowledge or at the school level when looking more generally at preparedness for graduation. When large batches of portfolios have needed to be reviewed in education, like during an AP assessment or as part of the college admission process, the batch size typically stays low since portfolios were restricted to a specific subject or type of artifact. These education examples unfortunately cannot support the proposed portfolio system which aims to collect artifacts from across a student's experience and used at scale throughout the education ecosystem. Here, the workforce uses of portfolios provide the best models. Either through human-driven review like that done by nurse certification bodies or the automated evaluation now being done on coding repositories, portfolio systems could benefit from an external entity evaluating a student's portfolio.

2.4 The Synergy Between Authentic Learning and Portfolios

As mentioned in the introduction, portfolios depend heavily on the quality of the artifacts that students produce. When used in the traditional setting, portfolios will primarily consist of tests, essays, and similar assignments oriented in artificial environments that offer little depth to the abilities presented. In contrast, authentic learning by its nature has students demonstrate their abilities in a natural environment, and as a result, the artifacts created often provide clearer examples of how the student can use their abilities to respond to real-life situations. The artifacts produced by authentic learning exhibit skills in practice rather than just in theory. An additional benefit of authentic learning experiences for portfolios is that they often capture aspects of a student's non-cognitive development better than traditional

artifacts. The activities students complete in an authentic learning require students to demonstrate creativity, cooperation, and resilience, mindsets often not used fully in a traditional assignment. Conversely, authentic learning practices can benefit from portfolios because the structure facilitated by the collection of artifacts provides a framework more conducive for evaluation of this learning compared to traditional assessments. Authentic learning by design lacks strict guidelines and rubrics to allow students of unique backgrounds to adapt an assignment to their interests. Students may choose different learning opportunities, yet when considering the skills and mindsets they need to employ, the distinct experience can easily exhibit the same set of abilities. Take for example the graduation standard of learning algebra: a student could demonstrate skills related to this standard by predicting a ball's trajectory for a physics project or by determining the order quantity for a product in their internship, two equally effective ways of demonstrating proficiency. Portfolios require an evaluation that considers an artifact in its context, much like how many authentic learning experiences need to be assessed. Together, portfolio and authentic learning approaches amplify each other's benefits to student learning.

Chapter 3

Initial System Architecture Proposal

This section describes an initial system architecture for combining authentic learning practices and portfolios to improve the US education system. The ARIES framework developed by Deborah Nightingale and Donna Rhodes helps structure the development of a transformed enterprise[1] into ten elements: Ecosystem, Stakeholders, Strategy, Information, Infrastructure, Products, Services, Knowledge, Organization, and Process (Nightingale and Rhodes, 2015). The initial architecture of the authentic learning portfolio enterprise integrates aspects of existing applications of portfolios and authentic learning experiences as well as best practices from published literature, and I used it as the initial basis for conversations with stakeholders. Prior to interviews and further case study work, the potential shortcomings of this system architecture were identified to determine what evidence would be needed to support this design for wider implementation.

3.1 Ecosystem

Our proposed enterprise will operate in the broader US K-12 education ecosystem. While the stakeholder groups will be discussed more in-depth in the next section,

[1] An enterprise in the ARIES framework has multiple meanings, including "*organization, firm, establishment, company*", yet for the purposes of my thesis, I will be using the term to describe multi-stakeholder effort to achieve a common set of goals (Nightingale and Rhodes, 2015)

the main organizational types I consider inside the ecosystem include the schools, which provide learning, and the entities that aim to leverage students' learning to achieve their goals. External to the ecosystem are entities, both formal in the case of governments and informal in the case of parents and the community, that observe the performance of the internal organizations. The external observers have varied goals, yet their purpose can generally be characterized as accountability, ensuring that learning outcomes meet their expectations. As for the policy landscape, the education system in the US reflects federalism with much of the decision-making that affects the system occurring at the local level, with the state governments making decisions about standards and funding, and with the federal government leveraging limited influence on the system through grant initiatives (Pelsue, 2017). The education ecosystem is also shaped by both economic and social factors in determining what kind of learning should occur. Economically speaking, the system aims to prepare students for careers after they exit school. In some cases, post-secondary education is required, yet employers generally exert the most influence in determine what skills are taught. Socially speaking, schools also prepare students to be active participants in society, and thus, certain competencies and qualities, such as timeliness, strong communication, and collaboration, are also prioritized in education. Notably, the economic influences often dictate the cognitive skills prioritized while the social influences impact the non-cognitive skills taught, with the interactions between cognitive and non-cognitive abilities reflecting how economic and social factors impact each other. Overall though, the ecosystem brings together groups which decide the qualities young people should have, implement the best ways to develop these qualities, and then evaluate students to ensure they achieve these qualities before they exit the system.

3.2 Stakeholders

The stakeholders in the education system play critical roles that will determine the success of the enterprise. While in the definition of the education ecosystem I divided

the stakeholders into groups based on whether they were internal or external to the system, the remainder of the system architecture considers them at equal footing because they have similar importance in determining whether implementation can succeed. Among all the stakeholders, the following have the most influence on the system:

- **K-12 Education Entities:** the schools and districts/governing bodies that manage them; provide the educational environment for students
- **Higher Education Institutions:** provide an instructional environment for some students after they graduate; more importantly for the enterprise, select students for admissions based on internal preparedness standards
- **Hiring Managers/Employers:** select students to hire based on their internal qualification requirements/preferences
- **Government Education Agencies:** review the performance of K-12 Education entities, and some Higher Education Entities, and issue incentives/consequences to achieve policy goals; exist at both state and federal levels

These stakeholders differ in the salience they have to the enterprise. Using Ronald Mitchell's model of stakeholder salience (Mitchell et al., 1997), K-12 Education Entities can be classified as "Dependent" stakeholders because they both have legitimate and urgent claims to change the system, yet under current policy, has less power to influence the decision. Mitchell's model would classify Higher Education Institutions as "Dominant" stakeholders because they have both powerful and legitimate claims to encourage the enterprise, yet they may lack urgency to change if not given the proper conditions. Next, we can classify Hiring Managers and Employers as "Discretionary" stakeholders as they have, due to their operations being dependent on the output of the previous two groups, a legitimate claim towards changes, yet lack formal power to encourage other stakeholders and may have less urgency if their needs are currently met. Finally, Government Education Agencies and other groups which manage the

school system would be the sole "Definitive" stakeholders as they maintain the formal power, legitimacy, and urgency to enact the systemic changes needed for the enterprise to succeed.

Additional stakeholder groups to consider in the stakeholder salience model include community members, parents, and students as while they may not have direct roles in implementing the system, their support is critical to its success. Based on their current position in the ecosystem, these groups would likely be classified as "Dangerous" stakeholders since they generally have power through their financial and political influence as well as urgency to support a successful system, yet often lack formal legitimacy in the decision-making process (Mitchell et al., 1997). This group in recent years has shown a more active interest in getting involved with system-wide decisions, as demonstrated by the increased participation in school board meetings and education-related legislation efforts (Sawchuk, 2021). Without legitimacy in the process, however, they can create obstructions to well-intentioned efforts to improve the system, like in the case of Maine's attempted performance-based graduation standards. A full stakeholder salience map can be found in Figure 3-1.

3.3 Strategy

The overall vision of the proposed enterprise is to prepare students for success in their careers and personal lives as they face the world's growing challenges. The enterprise will strategically do this through system-wide efforts that foster more authentic learning experiences in classrooms, transition towards authentic assessment approaches, and consider the unique operational challenges faced in different community landscapes to make the system more accessible to all students. To achieve these strategic objectives, the enterprise will use portfolios as a facilitator for other changes needed to support the enterprise's success. The proposal aims to broadly change the whole US education system, requiring critical stakeholders to play specific roles in implementing the strategy. In the initial design for this project, the system's main stakeholders will serve the following purposes:

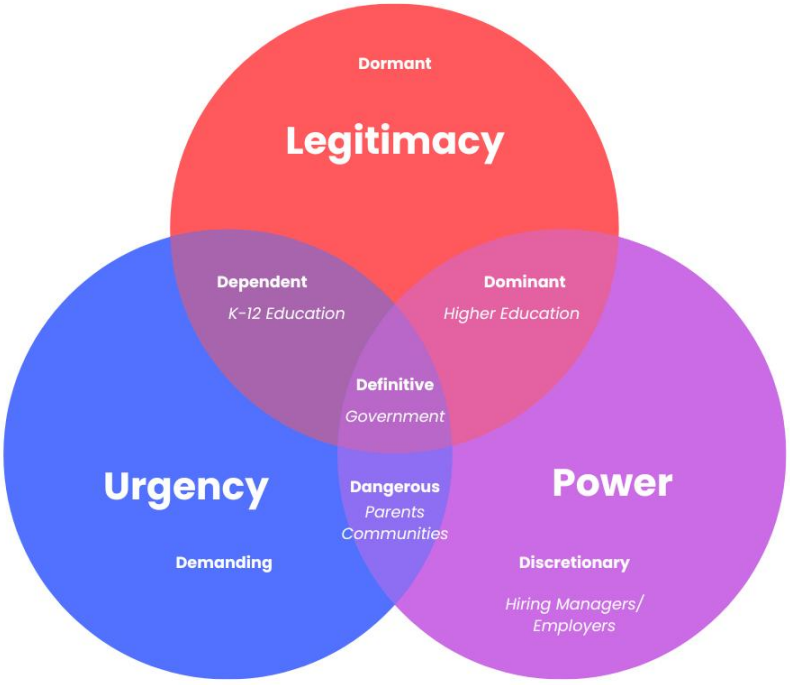

Figure 3-1: Stakeholder salience map for authentic learning portfolios.

- **K-12 Education Entities:** help students populate and prepare their portfolios, evaluate portfolios to aid with instruction
- **Higher Education Institutions:** set standards for use in determining college readiness, provide support to students in constructing portfolios to meet standards, evaluate portfolios for college entrance/admission
- **Hiring Managers/Employers:** set standards for use in determining workforce readiness, evaluate portfolios for hiring decision
- **Government Education Agencies:** set standards for use in determining graduation readiness, assess portfolio as a school accountability measure

3.4 Information

Authentic learning artifacts make up the most important information used within this proposed enterprise. Artifacts here specifically denote any physical or digital

product created by an experience contributing to a student's overall development. A non-exhaustive list of examples includes documents, correspondence, presentations, photos, and videos, yet the actual artifacts will depend on the nature of the experience. A student will primarily select artifacts produced by in-class experiences, especially when their school uses one or more authentic learning approaches. Project-based learning is particularly conducive to creating useful artifacts as it often involves a variety of work products that document the student's thought process through the course of the project. Artifacts need not be only from in-class activities though; students learn many of their non-cognitive skills through their extracurricular activities as well (Carolan, 2018). The enterprise should then also allow for the use of work examples from outside the classroom to present the full narrative of a student's development. These artifacts may require additional validation as they lack the implicit trust given to in-class assessments, yet for many students, they may better represent their abilities as they often will directly connect to their interests.

Artifacts alone, however, will not provide all the information the enterprise needs to offer its services, so the portfolio infrastructure should also include written reflections from the students that contextualize the other artifacts with the student's broad developmental narrative. A written reflection will further display a student's thought processes and capture aspects of their non-cognitive development missing from the work examples. Metacognition, the concept of how an individual thinks about how they think, is one of the most important non-cognitive qualities reflections will reinforce and exhibit; studies show that strong metacognition is often correlated with other positive student outcomes such as higher high school and college completion (Gabrieli et al., 2015). The reflections are also a piece of information that makes each student's portfolio unique to them. Students may include similar artifacts due to them having similar experiences, yet the reflection allows each to explain the unique impacts the experience had on their development. Truly, the reflections become some of the most important information during the evaluation process as they can help guide the evaluator on how to approach the artifacts collected. Rather than guess what each artifact shows about the student, an evaluator can use a reflection

to identify what the student believes the artifact demonstrates and thus assign an appropriate rubric to it.

While the artifacts will provide much of the insight into student qualifications during portfolio reviews, metadata resulting from storage of the portfolio can support certain conclusions about students as well. Using applications developed to parse coding repositories as inspiration, the enterprise needs to develop methods that extract key insights from metadata. In the coding repository examples, applications used metadata collected when a developer contributed to a project to track an applicant's commitment to projects, level of engagement with the community, perceived quality of contributions, and even the extent to which the developer uses their listed skills (Marlow and Dabbish, 2013). In the parallel case of undergraduate admissions, applications could use metadata from portfolios to identify the breadth and depth of a student's contribution to group efforts and measure the quality of their engagement rather than just relying on the length of their involvement. This metadata approach can rely on the growing literature on learning analytics to support its development (Ferguson, 2012). Specifically, metadata-based approaches would benefit from identifying the actionable insights the data could provide first rather than just unguided looking for correlations in the data. The most useful applications of the information collected in the enterprise would leverage research to validate the meaning of its correlations, thus any implementation of the enterprise must first go through rigorous evaluation to prove the validity of its conclusions.

3.5 Infrastructure

The portfolio provides the critical infrastructure needed for this enterprise by facilitating the persistence of artifacts past their usefulness in a specific classroom. The design of the portfolio infrastructure takes inspiration from Richard Larson and Soheil Sibdari's proposal in "From Rote to Wrote: College Admissions via Secure ePortfolios". In the Larson-Sibdari implementation of portfolios, students annually submit work examples along with written reflections contextualizing the artifacts con-

temporaneously over their four years of high school, creating a multi-year record of their cognitive development (Larson and Sibdari, 2020). Teachers or other school-associated adults then certify portfolio additions before storing the collection on a remote, secure server to ensure student honesty and portfolio integrity. They orient their infrastructure towards the needs of college admissions who can then consider student's artifacts as complements, and even substitutes, to existing parts of their admissions application. This iteration of the enterprise expands the potential use cases of the portfolios to also include review by teachers, accountability organizations, and employers. As a result, the portfolio infrastructure will need to allow fluidity in how collections are presented so multiple purposes can be achieved.

While portfolios have long-existed as physical collections, digital ePortfolios better serve the strategic objectives of the enterprise. With more students connected with technology at home, ePortfolios pose less physical burden by eliminating the need for storage of physical artifacts. Additionally, ePortfolios can interface better into stakeholders' existing processes; rather than having to send a physical collection of artifacts to each entity the student chooses, an ePortfolio allows them to simply send a link to their repository and give immediate access. Finally, ePortfolios offer an increased sense of the security and integrity about a student's portfolio. This benefit appears even more important in recent years following many major scandals surrounding admissions fraud. Exemplified by the Varsity Blues investigation, increased attention has been given to the embellishment and manipulation of measures of academic ability (Kasakove, 2021). As for specific security measures, the ePortfolio infrastructure should:

- **Provide a minimum level of trust that they cannot be tampered with through storage on a remote, secure server:** Schools then will have less responsibility to prevent intrusions and systems can be more uniformly operated across districts.

- **Control read and write access that only students can write artifacts to their portfolios and all users have read-only access to artifacts after**

they are added: With these policies enforced, evaluators can have confidence that artifacts originate from the students and that they were not manipulated at a later date.

- **Verified artifacts as authentic student work before submission to a portfolio:** This process, described in further detail later in the system design, will require a school-vetted adult familiar with the student's background to confirm the included work reflects the student's abilities and mindsets.

3.6 Products and Services

Portfolios provide necessary infrastructure for the enterprise, yet they also serve as the primary product of the operation as well. A student's completed portfolio can act as a representation of their educational journey and as evidence of the skills and mindsets they bring to the challenges they encounter. While not a physical product, students will have ownership of their collections and can use them as they see fit to help accomplish their goals. In this way, portfolios will act very much like a certificate students may have normally received from completing a course or education program. A portfolio can certainly include their diploma and other certificates of accomplishment, yet their collection of artifacts goes further than just indicating they met certain standards. An interested party can investigate a student's portfolio to see examples of them using their knowledge in action. Additionally, they can see the unique approaches and processes that a student employs to solve a problem and understand how their cognitive and non-cognitive abilities relate and interact. Despite all its possible uses, a portfolio has little value unless parties have the capacity to use them; this enterprise architecture must also consider the services that can utilize a portfolio.

The enterprise's services will consist of the actions through which stakeholders contribute to the strategic objectives: foster authentic learning experiences, transition to authentic assessments, and improve access to quality education across localities and student backgrounds. Primarily, the enterprise will serve students through the

authentic learning experiences it encourages. As previously mentioned, portfolios do not improve education alone; they require complementary practices which generate artifacts that capture the breadth of a student's qualities. The enterprise can provide this needed service by connecting stakeholders with the knowledge generated, which will be discussed in depth in a later section, on the best ways to bring authentic learning into the classroom. Through the schools, these efforts can then produce improvements to learning outcomes and help students develop the qualities they need for success.

Beyond learning, the enterprise also serves higher education, workforce, and accountability stakeholders by offering alternative evaluation and assessment methods. The enterprise provides this service primarily through the actions of the relevant stakeholders, yet it may require the creation of additional organizations with the sole purpose of producing useful evaluations of portfolios. Internally, stakeholders will need to adjust their evaluation processes to accommodate the new variety of information they will have access to. The process need not be a manual one, with recent advances in artificial intelligence for college admissions and hiring showing valuable, albeit controversial, progress (Burke, 2020; Chen, 2023). Regardless of whether an entities chooses man or machine for its process, determining their approach early in adopting is of utmost priority as it will likely impact their ability to achieve their goals since portfolio reviews would increase time strain on their systems. External reviews done prior to stakeholders receiving portfolios can lessen the strain by reducing and summarizing the main qualities exhibited by an artifact. The previously mentioned third-party evaluators will develop their own evaluation procedures in consultation with the relevant stakeholders. The resulting reports on portfolios can then be used by the stakeholders in conjunction with the supporting artifacts in the review process, reducing the time needed to develop their own conclusions on the student's ability. This service would require much more formal organization of the enterprise, which I will outline in a later section.

Finally, the system indirectly services the entire education ecosystem by responding to the challenges faced by schools trying to adapt "one-size-fits-all" education

resources to their unique community situations. As the schools that students attend vary greatly in the resources available and experiences provided, the enterprise needs to ensure that these differences have little impact on the end results of its processes. For example, a student should not be penalized for a portfolio that may lack a certain kind of experience (such as professional work experience in their field) if the student did not have easy access to that opportunity. Conversely, students who go above and beyond the offering of their locality should still be rewarded for their initiative yet not given too much advantage over their peers who may not have had the means to pursue a similar experience. The enterprise can provide this service due to the flexibility offered by the portfolio infrastructure and the authentic learning environment that the proposal advocates for. Artifacts included in a portfolio reflect the environment they are created in, especially when their teachers use project- and community-based learning principles, and the added reflection further reveal the student's context so evaluators can orient their reports to the student's background.

3.7 Organization

The organization of the enterprise varies between the stakeholder groups represented. At the lowest level, schools serve as the facilitator of the student's learning experiences and construction of their portfolio. The enterprise requires changes in the school's organization that allow teachers more autonomy in the learning experiences they offer while also fostering more collaboration between classrooms and with the community. Autonomy becomes important in implementing the enterprises as students need learning experiences that respond to their needs; a one-size-fits-all approach will not work well with the enterprise as it cannot address the differentiation needed to engage all students with learning. The enterprise also pushes learning beyond one classroom's walls, so a school organization oriented around collaboration will best connect students with the mentorship and opportunities they need to explore their passions fully. As this organizational shift will be substantial, schools will need to be consulted to determine how it could be implemented while taking all related stakeholders into

consideration.

While school organization will be determined with what best facilitates authentic learning, the organization of the remaining stakeholders–colleges, employers, and accountability organizations–is instead focused on optimizing the evaluation process. As discussed previously, the enterprise will pose a larger time and resource burden to conduct evaluation than the conventional systems. To reduce the number of times a portfolio undergoes evaluation, the development of an intermediate organization between schools and evaluators would be necessary. The intermediary organization would employ domain experts to assess portfolio artifacts using a standardized rubric and create a summary of the qualifications exhibited by the raw artifacts. Stakeholders need to trust the entity behind the intermediary evaluator since its decisions will greatly affect the validity of portfolios as an evaluative tool. Potential entities that could support the intermediate evaluators include domain-focused organizations like the National Academies, assessment-focused organizations like the College Board, or consortiums of stakeholders like the Coalition for College Access. Additionally, a new non-profit organization could also support the organizational needs of the enterprise, yet this would require larger effort than relying on existing organizations. Regardless, the intermediary evaluation organizations can reduce the burden of implementation on the stakeholders and drive the success of the enterprise.

3.8 Knowledge

Knowledge[2] in the authentic learning portfolio enterprise will primarily include the evaluation processes developed by stakeholders to extract meaning from portfolios. As seen in the past uses of portfolios in the workforce, different entities will set different standards and expectations for what should be included in a portfolio (Ward and Moser, 2008). Entities in the same areas (i.e. colleges with similar academic offerings, states with similar education standards) can collaborate on shared standards to use

[2]In the ARIES framework, "Knowledge" comprises of the competencies and expertise created by the enterprise; this differs from the aforementioned "Information," which instead includes any information required for the enterprise to operate (Nightingale and Rhodes, 2015).

in evaluation, and these standards will not entirely be mutually exclusive to allow students to use their portfolios across numerous purposes. To navigate the diversity of expectations among stakeholders, the enterprise will develop the expertise in helping students develop "portfolio literacy" which has been seen as a critical skill in industries like art and design with long experience in using portfolios (Barnes et al., 2022). "Portfolio literacy" as a competency would include comprehending the differences in standards and understanding how to choose the best artifacts from their general collection to convey the information an organization needs.

Beyond general "portfolio literacy," the enterprise also generates knowledge in individual communities on the best ways to engage students with learning. Whereas traditional education enterprises rely on a small set of approaches that have varied effectiveness for students of certain backgrounds, the enterprise will generate various curricular and pedagogical supports that address the specific needs of students. This breadth of knowledge can be better utilized by the enterprise when teachers and schools have opportunities to share with their peers. Open Educational Resources[3] hence becomes a major approach that the enterprise can use to organize the knowledge it generates. By capturing curricular knowledge in OERs, the enterprise can support the system through the dissemination of best practices. Repurposing and adapting resources expands their usefulness, allowing important tools to reach a wider audience. (Hilton, 2016). The circulation capabilities of OERs will play a critical role in ensuring the widest spread of authentic learning portfolios.

3.9 Process

Successful execution of portfolios will require the development of robust processes that control the flow of information into useful products and services for the enterprise's stakeholders. Following the conceptual review of portfolios by Strohmeier, the

[3] "Open Educational Resources (OER) are learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others." ("Recommendation on Open Educational Resources (OER)", 2019)

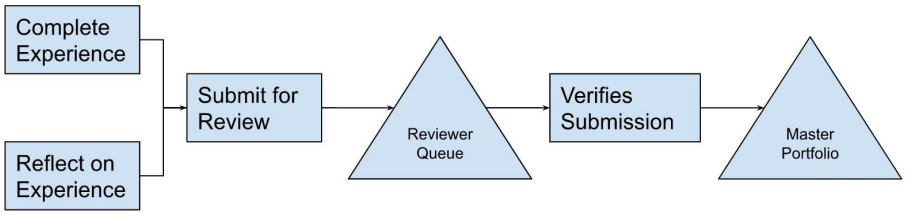

Figure 3-2: Process map for creating a portfolio.

enterprise will need to support three main purposes: development, assessment, and documentation (Strohmeier, 2010).

3.9.1 Portfolio Creation

Portfolios' value depends on the quality of the artifacts enclosed; unless the enterprise helps students produce interesting artifacts, then the system falls short of achieving its strategic goals. The portfolio creation process serves as the bridge between the authentic learning experiences chosen for implementation and the portfolio as the storage location for the new information generated (see Figure 3-2). At the beginning of the process, a student pairs artifacts of their learning with their self-reflections. These materials must then go to a trusted adult, either a teacher or school-vetted mentor, to verify the integrity of the student's work. As the environment in which artifacts are created is not controlled, verification provides needed assurance that the work captured in a student's portfolio is their own. After verifying their submission, the student can move it into their master portfolio.

3.9.2 Performance Assessment

To turn a master portfolio into one usable for performance assessment, students first need to consult a list of standards to determine what types of artifacts the assessor will need to see (see Figure 3-3). For performance assessment, these standards will connect to specific cognitive skills an interested party wants to determine if the student has. Each standard should have a corresponding rubric with which an assessor can

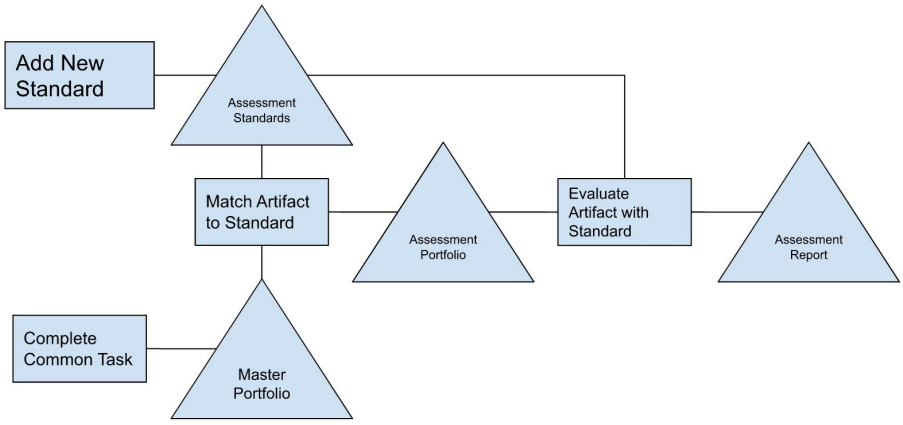

Figure 3-3: Process map for performance assessment using a portfolio.

compare a selected artifact against. The rubric should have evidence supporting its use to predict the student's proficiency with its respective cognitive ability. Using the provided standards, a student then selects artifacts from their master portfolio to construct a new assessment-specific portfolio they will distribute to their assessor. After the assessor applies the rubrics to the assessment portfolio, they will produce a report which summarizes the skills exhibited by the collection along with an indicator of proficiency.

As student artifacts will demonstrate variety in the media and approaches used, assessments may benefit from students completing a common task to help assessors calibrate their reviews. Examples of common tasks in current practice include PACE (the common task supplements individual districts unique assessment approaches) or the portfolio prompts used in University of Michigan's Ross School of Business undergraduate admission application ("Performance Assessment of Competency Education", n.d.; Willis and Martinez, 2023). Following specific instructions from the assessment entity, students will include the resulting artifacts from the task along with their personal artifacts in their final portfolio. The common artifact will allow assessors to determine whether a student meets minimum proficiency for the skill, and the personal artifacts will validate the student's further mastery of the skill

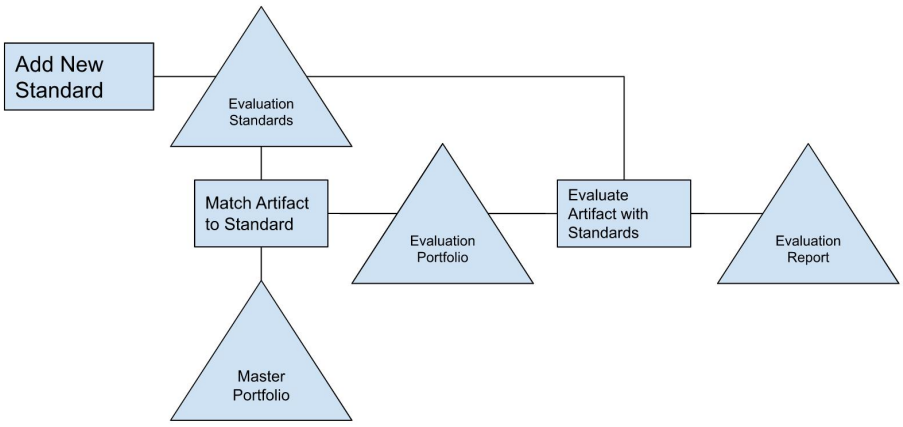

Figure 3-4: Process map for candidate evaluation using a portfolio.

3.9.3 Candidate Evaluation

Candidate evaluation will follow a similar process to that used for performance assessment, yet the focus in this process will be to summarize a student's non-cognitive qualities (see Figure 3-4). Again, students will select artifacts from their master portfolio which they feel best encapsulate the standards the evaluator sets for their portfolio intake. Each standard will have a corresponding rubric which has documented validity in its prediction. Using the students evaluation-specific portfolio, they will review artifacts against their respective rubrics and produce a report summarizing the qualities demonstrated. As non-cognitive qualities can less easily be quantified, the evaluation report instead will provide qualitative findings which highlight the non-cognitive qualities demonstrated by a student's collection. Additionally, the evaluation will not provide a common task as the evaluation could get better results from considering how the student responds to real-life situations.

3.10 Remaining Questions Surrounding System Adoption

The above system architecture covers many of the operational challenges demonstrated in past work on portfolios and authentic learning approaches. Implementing the system, however, requires additional information on the needs and concerns of the primary stakeholders as the enterprise uses existing practices in novel ways.

3.10.1 Acceptance of Required Changes

The enterprise will challenge many existing processes and system structures, and implementation with considering the systemic impacts of the proposed changes would likely lead more issues to propagate. As each stakeholder's acceptance of the system will determine its overall success, interviews with stakeholders need to reveal any remaining operational difficulties that may discourage entities from fully participating in their strategic role. Across education innovations, limited capacity of staff and resource constraints will likely create the biggest issues for stakeholders. Verifying that the proposed design features respond to their concerns takes high importance then in determining the next iteration of the design.

3.10.2 System Centralization

The enterprise will require entities to take on new roles within the ecosystem as well as new organizations to be created to fill in any gaps in capacity remaining. With shifts in the roles of stakeholders, trust will likely need to be rebuilt to ensure cooperation. In considering the steps to implement the enterprise, the eventual system architect must consider what each stakeholder finds most important in determining who should fill each new role. Specifically, organizations will likely have the most stipulations for what organizations take on the roles of evaluation and assessment. Ideally, stakeholders will indicate which types of organizations, and maybe support

specific organizations we have identified, to help guide future iterations of the architecture.

3.10.3 Perceived Challenges to Cooperation

As mentioned earlier in my discussion of the barriers to implementation, stakeholders may hesitate in supporting the system if they perceive that other stakeholders cannot support the system adequately. From my review of stakeholder salience, K-12 Education Entities, Higher Education Institutions, and Hiring Managers/Employers will likely be most susceptible to these perceptions as they all lack features that would ensure their buy-in could initiate systemic change. Colleges, for example, lack urgency to enact the change if they perceive that K-12 Education Entities will not implement the enterprise satisfactorily. Likewise, K-12 education entities lack power to enact changes to the system that Higher Education Entities and Government Agencies can use. The next iteration of the system architecture should consider how the stakeholders' perceptions impact their willingness to cooperate with each other, and additional design considerations may be needed to address these perceptions in the implementation plan.

Chapter 4

Current Barriers to Adopting the System

4.1 Operational Barriers

The limited capacities of the stakeholders in the education ecosystem may make it difficult to implement some features of the previously outlined system architecture. Fortunately, existing literature documents and explores many of the operational barriers faced by the education ecosystem, making it easier to address them in the final system architecture. The following sections describe the documented challenges the proposed enterprise will have to address in its operational strategy.

4.1.1 Time/Resources Needed

The flexibility and authenticity of portfolios may create new value for many of education's stakeholders, yet this value comes at the cost of more resource-intensive processes to operate and maintain the system. Portfolios will provide educators with deep information about a student's development, rich with details and nuances that can help the college admissions or hiring reviewer understand what makes this student unique. With depth, however, comes a need for additional time to process the

information which many organizations do not have. Colleges, the likely recipient of most students completed portfolios, currently spend less than 10 minutes reviewing all the application materials for a single application (Korn, 2018). Conventional components like transcripts and score reports quickly and concisely present the information reviewers need. A portfolio would instead require a reviewer to spend time with each artifact to understand its context and then more time determining how artifacts interact with each other to reveal a student's full learning narrative. Employers have had similar struggles in reviewing portfolios; rather than considering the full portfolio, hiring managers often ask applicants to select the most important few artifacts to discuss during interviews (Whitworth et al., 2016). While the obvious solution would be to increase capacity and bring in additional reviewers, the nature of portfolio evaluation makes this difficult as they will require evaluators to have deep knowledge of the course materials to determine the merits of an artifact. For MIT's maker portfolio, they task a committee of faculty to review student's projects so they could best identify the qualities of artifacts which could correlate to success on campus ("Creative portfolios", n.d.; Peterson and Abelson, 2015). This has worked for the program while participation has remained near 10% of applicants (Peterson and Abelson, 2015). However, as the program begins to operate closer to scale, MIT among other adopters will need to change their approach.

As this proposal requires mass changes across the educational landscape, even initiating the system will exasperate the resource-limited players. The system will likely take the largest toll on K12 schools as they will need to do much of the groundwork to ensure that the learning environment can accommodate the demands of authentic learning practices. Unfortunately, many school districts struggle to provide beyond the minimum requirements due to limited budgets. AP courses, for example, can help students prepare for college enrollment, yet roughly 30% of schools offer no AP courses (Kim, 2021). Schools may also struggle to recruit quality teachers, leading some communities without the staff required to manage the program. As of January 2023, 36,000 teaching positions are vacant (Shelton, 2023). Efforts to fix the teacher shortage have increased post-pandemic, yet with some initiatives reliant on

soon-expiring recovery funds to operate, the struggles may exist for years and decades to come.

The staffing crisis in American schools demonstrates one way how resources can reinforce the downfall of reforms. With teaching positions left vacant, school staff must become responsible for a larger caseload of students. For counselors, their ratio to students averages around 408 students per counselor, meaning during the school year they will only have 38 minutes discussing college and careers with each student (Young, 2023). Teachers face a similarly difficult statistic with an average class size of 15.6 students in American schools ("National Teacher and Principal Survey (NTPS)", 2018). Adding practices like authentic learning and portfolios to their responsibilities will require teachers to spend additional time adjusting lesson plans and advising students. Without additional support, the burden can become overwhelming, leading some teachers to exit the profession. The high exit rates, both from early retirements or exits from young teachers, following the pandemic have seemingly escalated the shortage. As vacancies increase, the cycle continues, and reforms become harder to implement. Just as portfolios and authentic learning approaches depend on each other for success, the architecture of a systemic reform will likely need to consider what other actions must occur to prepare the environment for accommodating the changes.

4.1.2 Standardization

Portfolios and authentic learning's flexibility also pose operational challenges for the stakeholders that depend on the output of the K12 education system. Here, flexibility acts as both a blessing and a curse. While the needs of students and schools can be better accommodated by a system that allows for adjustment and adaptation, external stakeholders would then need to take on additional burden to understand a student's context prior to them evaluating a portfolio. Instead, they prefer conventional practices which have standardized learning environments and make comparison easier between communities. Advocates for standardized tests have long argued that a quantifiable measure like the ACT or SAT works better as it has similar meaning re-

gardless of a student's background (Cohen, 2021). While authentic learning portfolios do not necessarily prevent such comparisons, the extra work required to establish a basis for this comparison between different learning environments will likely dampen support. This standardization of portfolio reviews will likely require more stakeholder capacity than currently present, and the short time granted to both college and job applications would not support an adequate evaluation of the artifacts present.

Time issues aside, the variety of portfolios particularly will make evaluating diverse candidates even more difficult. The current system has its issues, with many critics arguing that the current standard approaches suffer from their own inequities. While the ACT and SAT market themselves as unbiased measures of student ability, research has shown scores may be more correlated with a student's family income, gender, or racial background than their innate abilities (Broussard, 2014; Hess, 2019; Reeves and Halikias, 2017). Transcripts similarly present an issue as the definition of A-quality work in one school may be different in another (Noonoo, 2022). Even measures like personal statements that receive more weight in holistic admissions, colleges' main attempt to make their process more equitable, have strong correlations with a student background that evaluations cannot easily separate from (Alvero et al., 2021). Portfolios would similarly exacerbate these final challenges as the variety of artifacts would amplify confounding factors. A standardized review process could inadvertently ignore context that would orient artifacts and allow for fairer comparisons of artifacts; for example, a standard process looking for a specific presentation of a skill, like using linear equations, may miss examples in which the skill is exhibited less obviously, like through a spreadsheet a student made for a personal finance class. A quick solution to the problem could be to first orient portfolios with a student's test scores, yet this would likely hurt the scalability of portfolios. With scores still easier to prepare for than a comprehensive portfolio, students will focus on their test scores first to improve their appeal and then select artifacts that align well with their scores. Dependence on standardized assessments could then cause the ecosystem to again prioritize conventional practices that do nothing to engage students over the harder-to-scale reforms that respond to a student's interests.

4.1.3 Equity

An effective implementation of authentic learning portfolios may also struggle to develop due to inequities across the ecosystem. Primarily, I will consider equity as providing each student a learning environment that responds to their unique needs and addresses disadvantages related to their specific background; by this definition, inequities in the ecosystem reflect situations in which students may not have appropriate accommodations for their abilities or lack access to classes and activities relevant to their past experiences. Of most concern for portfolios is a student's access to quality learning experiences. Often, those students requiring the most support will have the least opportunities to create compelling portfolios in the classroom. With artifacts being the primary demonstration of a student's qualifications, the quality of a student's experience could greatly impact an evaluator's perception of a student's abilities. Students that may perform similarly on the standardized assessments may thus receive vastly different evaluations of their portfolio since one student had access to more rich learning experiences in their school. Much like college essays which require students to have an implicit knowledge of colleges to look for, a student's ability to effectively demonstrate their qualification will also greatly depend on their "portfolio literacy" (Alvero et al., 2021; Barnes et al., 2022). As many underserved students will not have sufficient time with their counselors or teachers, they will have to struggle through putting together their portfolios alone like they currently struggle with their college applications.

Colleges and employers, the stakeholders who have the most reason to evaluate portfolios, will then have the added burden of determining whether differences in artifacts occur due to candidates' abilities or backgrounds. For example, the qualifications demonstrated by standardized test scores and transcripts are shaped by the opportunities available in a student's learning environment, yet since they generally follow a standard format, these factors external to the student are less apparent. However, a student's portfolio directly reflects their learning environment, as the artifacts represent how the student's abilities appear within their school's curriculum

and pedagogy. Schools that implement portfolios without complementary authentic learning activities then will make it harder for students to demonstrate their abilities beyond what can be shown on a test. Since some students will have the ability to demonstrate these less-observed skills, they again receive the advantage portfolios aim to address. Portfolios will thus likely not replace convention unless stakeholders can confirm all students receive equitable consideration of their abilities.

4.1.4 Compliance

Schools, especially public ones, face an additional constraint of complying with standards and policies set to maintain quality of learning. Policy controls K-12 schools in two ways that directly impact the viability of a portfolio system: holding schools accountable to demonstrating minimum academic progress and setting graduation and curricular requirements. The first way has traditionally relied on standardized assessments. As a result of No Child Left Behind, Race to the Top, and now the Every Student Succeeds Act, public schools now conduct regular assessments of student achievement to evaluate the effectiveness of schools (Klein, 2015, 2016). Schools often perceive making sure students feel prepared for examinations as a key part of maintaining a good standing with their state. In theory, this should then correspond with preparedness for life after graduation, but in practice, this has led to students feeling more prepared in taking tests. Termed as "teaching to the test," the presence of the high-stakes test often requires teachers to replace engaging lesson plans to ensure students have appropriate time to learn the material needed for the tests (Phelps, 2011). Outside of formal accountability, policymakers can control the behavior of schools through their approval power over curricula and graduation requirements. Like seen with other policies, this power can both hinder and harm authentic learning portfolios depending on how a state uses it. While some states enforce curricula and testing requirements that can shift resources away from providing authentic learning experiences, states can similarly introduce requirements like diploma seals in Ohio and senior projects in Colorado that mandate the adoption of the practices ("Demonstrating Readiness | Graduation Seals", n.d.; Spicer, 2019).

By determining what practices schools must comply with, policymakers can directly enact or indirectly impede the growth of the proposed system.

While colleges have significant independence in how they operate, policy can influence the requirements they use in admissions. The most direct way this has occurred for public colleges has been through controlling what they can consider during the admissions process. While the level of autonomy of colleges varies between states, most often undergraduate admissions have to respond to some direction from elected officials on how they determine what students get in. In the post-pandemic years, mandates typically focused on what colleges could consider standardized test scores in admissions. The University of California and California State systems, for example, made the decision to remove tests from consideration entirely (Watanabe, 2021). Advocates have noted this has given California the unique opportunity to include performance assessment via portfolios (Watanabe, 2021). Other states have taken the opposite actions, with Florida's and Tennessee's systems reinstating testing requirements (Satterfield, 2021; Wright, 2022). With tests required, schools within these states will again have incentives to prioritize tests and have less capacity than in test-free states to implement a proposal like this. Government's ability to influence college requirements, however, does not spell certain doom for authentic learning portfolios, as policy can just as easily encourage portfolios through its control as well as it can hinder them. With states often seeking synergy between their accountability practices and the admission demands of their public colleges, this operational challenge could become an opportunity if policy were to allow colleges to admit students based on their portfolios. The City University of New York demonstrated this with their pilot of an alternative pathway to admissions based on a portfolio submission. While limited to a small consortium of schools, early results from the pilot have shown students admitted through this pathway have higher first-year GPAs and persistence than their peers (Fine and Pryiomka, 2020). As colleges navigate the future of their admissions processes in response to changing policy priorities, they have the opportunity to take actions that will encourage change throughout the system.

In effect here, policy partially determines the external landscape in which students

and parents make educational decisions. Specifically, they set specific obligations in which schools must fulfill to participate in the landscape. These set obligations are what then limits how a transformation like authentic learning portfolios can operate. Consider first a school which aims to implement a system that does not easily support the obligations set by policy, like using portfolios as the primary form of assessment despite a state mandate to administer specific standardized assessments. Students will likely need some support on understanding how to take the test, yet unfortunately their class environment does not reinforce test-taking skills. Since students will lack familiarity with the tests, the school may then face lower test scores and the resulting consequences from its governing body. More time will be dedicated to test-taking skills at the expense of portfolio development and authentic learning, leading to the decline and eventual failure of the system.

Portfolios inclusive of existing compliance policies, however, likely face a similar viability issue. Now consider a school wanting to implement a system similar to the prior example, but this time the school considers compliance and balances it in priority. While schools dedicate a portion of class time to compliance, they may still perform less on the compliance measures than schools that chose not to implement the inclusive system. To stay competitive on the measure, schools will dedicate less time to the system and more time on compliance. The priority then again becomes compliance leaving little interest in maintaining the alternative system and preventing growth across the system.

4.2 Perceptive Barriers

Besides physical constraints, schools also face barriers to implementing systems based on their perceptions of other stakeholder's expectations. These barriers, while not necessarily grounded in actual constraints, make system implementation difficult unless they can be operationally overcome or challenged by stakeholder cooperation. Stakeholder cooperation appears to be most important in overcoming these barriers as by breaking down incorrect perceptions, schools can find new ways to motivate other

stakeholders to move towards adoption as well.

Authentic learning portfolios will involve many interactions between different stakeholders, so some groups will likely hesitate in adoption if they worry other stakeholders will not adequately meet their responsibilities. Similar to their concerns over compliance with state policies, schools may hesitate acting on portfolios as it may make their curriculum less favorable to colleges looking to admit their students. With college being the primary goal of high school for many students, changes to practices may raise concern that students will be put at a disadvantage by the new system. High schools frequently use the expectations of colleges to determine how they manage instruction; AP Calculus for example has proliferated in schools out of the perception that colleges reward students who take it in lieu of other, possibly more relevant math classes (Anderson and Burdman, 2022). The perception that colleges would punish high schools that shift away from convention lacks much standing, however. Consider the Mastery Transcript, which again has many similarities with a portfolio system that could support authentic learning; since it would radically change the information admissions would have access to, they have secured commitments from over 160 institutions that using the transcript would not be detrimental to applicants (Montes, 2021). Despite this confirmation, authentic learning portfolios may still face opposition from their community concerned that colleges, despite their messaging, will not accept the change. With parents becoming increasingly active in the decision making of their schools, radical shifts will be challenged unless the school board can satisfy community concerns (Sawchuk, 2021). As an example of challenges from parents, consider Maine who had to roll back their own attempts of implementing competency-based graduation standards; parents in the state worried that the new meaning of grade points would be lost on colleges, and students would appear less talented than their transcripts implied they were (Barnum, 2018; Barshay, 2018). Colleges could easily adjust their reviews to accommodate the changes, but since much of the process would remain private, families found the changes too risky for students in the short term to justify the long term returns. Without schools and community support, even the most well-intentioned changes to policy would be

challenged.

While colleges control much of the perceptions of the post-secondary transition, they do adjust their behavior in response to their perceptions of K12 education as well. Since their system depends on the output of K12 schools, colleges must anticipate the capacity of their applicants when designing their admissions process. Too difficult a process, less students will apply to a college and thus enrollment and revenue will decline over time. Difficulty aside, a college's application process depends on the stability of external organizations, namely high schools and testing organizations, to run smoothly. When these partners get interrupted, colleges must respond. The recent pandemic exemplifies this as colleges could no longer trust that all applicants could complete the required standardized tests by their deadlines; colleges shifted, as a result, towards test-optional policies with more 80% participating in the transition (Nietzel, 2002). As test centers reopened, however, many colleges remained test-optional. While the published reasoning varied, with most arguing that removing tests allowed them to admit a more diverse freshman class, one common trend across colleges was that the weakening of requirements increased applications (Belasco et al., 2015). Outside of the application, college's perceptions of high schools' effectiveness influence their instructional operations. Again, because of the pandemic, many students have enrolled in college with less than expected abilities in core cognitive competencies, leading to more remedial courses being offered and instructors adjusting their techniques to accommodate deficiencies (Fawcett, 2022). Both examples show that colleges need to consider the average student's abilities when determining their strategies. As for this proposal, colleges will likely face concerns over whether their applicants could create a product useful for their purposes. As mentioned previously, status quo schools will have difficulties due to low resources and policies detrimental to implementing authentic learning to an extent in which valuable artifacts are generated.

Chapter 5

Embedding Authentic Learning Portfolios into Policy

Local successes demonstrate that authentic learning portfolios work in concept, yet scaling the practice to work in different communities across the nation will require mechanisms beyond those available to individual schools. With most students attending public schools in the United States (49.5 million compared to the 4.7 million in private schools), state and federal governments will play a critical role in encouraging adoption of the practices ("Fast Facts", 2023). Policymakers appear to have two pathways they could follow to embed authentic learning portfolios into the fabric of public schools: allow for portfolio assessment in school accountability systems or require a portfolio for high school graduation. Each option has its own strengths and weaknesses, but they share the common effect of changing the culture of today's schools. Due to the fragmented nature of education in the US, enactment of these policies would need to occur at the local or state level, yet federal policy can also motivate local action. Policy-enforced transformations, despite the formal authority behind them, do not always succeed though, and without proper care, they can subside and cause a return to conventional practices. Pushback often occurs when students and their families perceive a transformation as potentially detrimental to their future. Even the most well-documented successes may fail in expanding if families worry

about the consequences of being an early adopter. This chapter considers instances in which governments took the above pathways to implement comparable education transformations, namely portfolio assessment and proficiency-based learning; by analyzing the conditions that led to each example, I identify what policy actions could lead to wide adoption of authentic learning portfolios.

5.1 Pathway 1: School Accountability Systems

A strong school accountability system consists of clear expectations of what good performance looks like, measures that track the academic progress of students with limited disruptions, and proper incentives to encourage school to continue improvement (Loeb and Figlio, 2010). Throughout the history of the American education system, policymakers have made numerous attempts at perfecting an accountability approach, yet their efforts have typically fallen short. From early state-based efforts to No Child Left Behind and Every Student Succeeds, the system often leads to misaligned incentives for schools, with many classes focusing on "teaching to the test" rather than pursuing engaging practices (Phelps, 2011). By positioning authentic learning portfolios as an alternative to the standardized tests that accountability systems mostly depend on, state and federal governments can put proper emphasis back on engaging instructional methods. To do this, the federal governments needs to afford state governments and the school districts they represent the autonomy to design assessments considerate of their community's needs.

5.1.1 Early Efforts

Prior to 2002, individual states decided whether they needed an accountability system, and the few systems that did exist had little similarity. The early accountability systems showed significant improvements in math and reading on the National Assessment of Educational Progress, a standardized test focused on national rather than local achievement; states that attached consequences to accountability measures saw even larger gains to those that simply reported out data on school performance

(Dee and Jacob, 2010). Despite early gains from accountability systems, adoption remained limited, with only 29 states by 2002 having adopted "consequential accountability systems" and 7 states making no effort to track student achievement in schools (Alderman, 2015). Accountability measures during the early era also corresponded to the specific needs of each state, meaning that states faced the burden of developing custom assessments that were more costly than today's nationally available options. With the lack of national direction, states did not have a clear set of benchmarks they could use to characterize students and instead looked for differences relative to a student's or school's peers (Dee and Jacob, 2010). As a result, system wide trends lacked a foundation that could guide policy discussions on the direction of educational systems. On the spectrum from strong state to strong national authority, school accountability pre-2002 falls definitively on the side of strong state control. Notwithstanding the limitations local assessments had, the lack of strict system requirements fostered some innovation regarding assessment strategies. Vermont and Kentucky, for example, individually developed accountability systems that utilized portfolio assessments as their primary measure (Holland, 2007). Even with these advances in practice, federal legislators recognized the growing collective action problem before them; accountability appeared too costly for most states to take on alone, yet all would likely benefit from enacting it. Federal action thus appeared necessary to scaling a strong accountability system nationwide.

5.1.2 No Child Left Behind

The No Child Left Behind Act (NCLB) of 2001 became the largest federal intervention into public education of its time, and it directly responded to the need for more wide-spread enactment of school accountability systems (Klein, 2015). The act used access to federal funding to enforce strict standards for what a satisfactory accountability system would entail. States were required to administer standardized tests on the core academic subjects (i.e. math and reading) annually to students (Klein, 2015). NCLB ensured that all states would use the same assessments and metrics, so early experiments in accountability went to the wayside. Vermont's and Kentucky's

experiments in portfolio assessments were stopped short by the enactment of NCLB, though research at the time revealed struggles with maintaining consistency and the systems' high costs that would have likely resulted in a rollback regardless (Holland, 2007). NCLB placed emphasis on standardization and comparability between schools. Systems no longer needed to make relative judgements on the performances of schools as they had clear benchmarks each school should meet. In theory, the goals set by the benchmarks would motivate teachers and principals to improve instruction. The emphasis on test scores, amplified by the potential financial impacts of not meeting a benchmark, however proved too consequential. This instance of high-stakes social decision-making created the perfect environment for Campbell's law to take effect. Due to the high value of good test scores, schools started to take actions later categorized as "teaching to the test"; these practices emphasized test-taking strategies and rote memorization over problem-solving and critical think to many students' detriment (Schoen and Fusarelli, 2008). As a result of "teaching to the test," schools had less incentive to pursue authentic learning and portfolios because the practices would not lead to direct improvements of test scores. NCLB also represented a loss of local autonomy. While strong federal intervention helped establish common standards and ease the burden developing a system would pose to many states, the movement of accountability away from local control made it harder for schools to address their unique needs. The one-size-fits-all nature of NCLB led to student disengagement over time as instruction and assessment felt less relevant to their needs. Authentic learning portfolios can reestablish engaging practices, yet only if policy balances the need for national cooperation with the need for local autonomy.

5.1.3 The Every Student Succeeds Act

NCLB's replacement, the Every Student Succeeds Act, introduced less restrictive requirements to how states conduct standardized testing and school accountability (Klein, 2016). The ESSA, passed in 2015, reduced the federal government's role in education by shifting much of the responsibility of standards-setting back to the states. The Department of Education took on an advisory role in regard to the devel-

opment of benchmarks. The act did not fully eliminate federal intervention though; the federal government still had enforcement authority over the state-designed plans and could use federal funding to incentivize innovation and improvements. Primarily, the act made it easier for states to design their own standardized assessments; with this additional autonomy, states began to experiment with integrating portfolios and related-assessment strategies into schools again (*POLICY, PILOTS AND THE PATH TO COMPETENCY-BASED EDUCATION: A National Landscape*, 2017). New Hampshire, for example, developed the Performance Assessment of Competency Education (PACE) to serve as a component of its ESSA testing; PACE still utilizes some standardized tests to calibrate its findings, yet much of the assessment comes from locally developed performance tasks which could easily make up a student's portfolio ("Performance Assessment of Competency Education", n.d.). A consortium of schools in New York took similar advantage of ESSA's flexibility to seek exemption from all tests except the English Language Arts Regents Exam to instead base assessments on student portfolios and evaluations from teachers ("About Performance Assessment", n.d.). The ESSA represents a middle ground between the uncontrolled autonomy of the early accountability systems and the strict federal control of NCLB. While ESSA still requires compliance with basic common standards, states have more authority to design systems that best respond to the needs of their residents (Klein, 2016). The ESSA, however, still requires improvement; while schools now have more freedom to use test alternatives for accountability purposes, the adoption of more engaging practices has stagnated due to a lack of government support.

5.1.4 Current Status of Test Alternatives

While ESSA has allowed progress towards the use of authentic learning portfolios in accountability systems, states have continued to use standardized tests due to their ease and less cost to implement at scale. The ESSA specifically established the Innovative Assessment Initiative to encourage schools to think beyond simple tests to meet accountability requirements, yet the program struggles to make meaningful change due to the remaining federal regulations on testing. The program suffered

from lack of funding for participating states, meaning that efforts to move towards more costly portfolio assessments would need to be self-funded (Javurek, 2021). Additionally, many states only made minor improvements to test delivery due to many sites trying to produce systems that would provide similar data to their legacy systems (Javurek, 2021). Whereas NCLB led the development of standardized tests for the states, ESSA shifted this responsibility back to states along with its authority to set standards. Portfolio assessment, due to its high cost, struggles to win favor of parties ambivalent to its use, so unless states can meet a specific need with the practice, they will likely maintain the more affordable status quo (Strohmeier, 2010).

States that have developed portfolio assessments for school accountability have often done so to support the needs of specific student groups. While states like Massachusetts continue to administer a standardized test to the vast majority of their students, they have implemented portfolios to support students with disabilities (Dixon, 2003; Wiener, 2006). As these students may struggle with the conventional, portfolio assessment has mass appeal as it allows students with disabilities to exhibit their learning in the ways most comfortable to them. Portfolio assessment for students with disabilities has a long history. Even in the strict testing regime of NCLB, school districts could offer students with significant disabilities an alternative assessment, often using a portfolio, while still staying in compliance with the federal rules (Cortiella, 2005). The ESSA, despite its general push for more local authority, placed some additional restrictions on the use of a portfolio assessment, capping districts from administering it to more than 1% of their students (Samuels, 2018). With such a small proportion of students completing the alternative assessment, capacity does not pose an issue like it would if all students completed a portfolio instead of a test. Though concerns have grown among special education teachers over whether a portfolio can be a trustworthy and insightful assessment tool, the philosophy behind its inclusion connects back to the general rationale for using authentic learning portfolios over standardized assessments; the practice allows students to demonstrate their proficiency in the ways best suited for them.

The history of school accountability in the US shows that federal and even state

interventions into the operations of local schools can impede innovation. With the local successes of authentic portfolios often occurring due to schools having the authority to design experiences and procedures that respond to the unique needs of their communities, the scaling of the practice will require limited federal intervention unlike what existed under NCLB. Conversely, a fully fragmented system impedes the growth of authentic portfolios as well. If a common set of standards were not developed for portfolios, they would likely have little value outside the school they were created in. As seen in the workforce uses of portfolios, value can only be extracted from a portfolio once a discipline decides on what they wanted to see included (Ward and Moser, 2008). Since establishing standards would be difficult without some federal intervention, the fully-state-designed accountability systems pre-2002 would also be less ideal for scaling the proposal. Existing in the middle of the spectrum of control, the ESSA along with complementary legislation like Innovative Assessment Initiative makes the current policy environment most adept to implement authentic portfolios more widely. Schools will likely require additional financial and information support from state and federal governments to justify the transition, yet with the proper incentive, schools have the authority to design a portfolio system responsive to their community's needs.

5.2 Pathway 2: Graduation Standards

As seen with the outcomes of ESSA, allowing for innovation to occur often still results in the status quo; with the high implementation cost of authentic learning portfolios, schools may require direct orders to implement the proposal. By integrating the practice into graduation requirements, states can spark initial adoption that will grow as schools gain experience. Traditionally, states have used graduation standards based on "seat-time" measures; these standards look for students to complete a certain number of credits in each subject area the state or local district deems important (Ingraham, 2021). These standards make up the minimum that public schools need to ensure their students complete, yet individual districts can add their

own requirements (such as volunteer hours or a college/career seminar) if they see fit. Seat-time standards have received criticism in recent years due to students having the necessary credits yet cannot demonstrate the purported skills they have in practice (Ingraham, 2021). This discrepancy has often been proposed as an explanation for why GPAs have appeared to rise while standardized test scores remain stagnant or decline (Noonoo, 2022). To ensure students graduate with the necessary skills, some states have pursued other frameworks for their state minimum requirements.

A state could encourage authentic learning portfolios by adopting a more radical framework for its graduation standards, specifically proficiency-based standards. Instead of looking at courses completed, these standards require students to demonstrate specific abilities and milestones ("Verifying Proficiency", n.d.). For example, instead of requiring students to complete a certain sequence of math courses, students would need to provide evidence that they have mastered certain math/analytical skills. Competency standards have led many schools to implement portfolio-like systems to help students to collect evidence and demonstrate their competency. States have implemented portfolios due to these standards with mixed results, however.

5.2.1 Successes in Vermont

Vermont transitioned to proficiency-based standards starting with the graduating class of 2020. Their transition required moving away from seat time towards "demonstrations of student proficiency" ("Proficiency-Based Graduation Requirements", n.d.). The state's approach used a "Portrait of a Graduate" (PoG) that would help school districts develop their own local standards. Using the local standards, schools determine if a student can graduate once they demonstrate, through artifacts from class and outside school, they have proficiency in the needed areas. Again, the proficiency standards make up the minimum requirements to graduate, and most schools also offer opportunities for students to go beyond and demonstrate additional proficiencies. While still early in its implementation, Vermont has found some successes in its adoption. At first, school districts found difficulty implementing local standards due to limited state support and guidance (Hewitt and Duffort, 2019). However in recent

evaluations of the transition, surveys showed that state education experts "remain optimistic" and "some students have increased their engagement with the learning process as a result of the changes" (Bhalla et al., 2020). Students who have experienced Vermont's transformation in its entirety will now have started entering college and the workforce, so additional data should soon become available to determine the program's success.

5.2.2 Struggles in Maine

Maine also adopted proficiency-based standards early, yet the state unfortunately could not overcome challenges with securing stakeholder buy-in and rolled back changes in 2018. In analyses of the changes in Maine, experts have identified that many schools struggled to move away from traditional practices, like standardized tests, to offer true customizability to students (Barnum, 2018). Additionally, many Maine school districts faced challenges from students and parents worried that the proficiency-based standards would require structural changes that would affect students' college chances; for example, grading systems often changed from a 0-100 scale to a 1-4 scale where most students who had not achieved proficiency yet received 2s, affecting class rankings and GPAs (Barshay, 2018). Since local school districts still have final say over requirements, many schools have continued use proficiency standards and portfolios after Maine rolled back the standards in 2018. More generally, however, Maine schools have returned to normal at the request of parents and families. The concern over whether a transformation will affect a student's future will greatly impact whether authentic learning portfolios can scale, as demonstrated by Maine. Many of the practices attempted in this iteration of proficiency-based graduation standards received the support of colleges and universities. While the number on the transcript changed, colleges maintained that by using recommendations and school profiles, their admissions teams would still have all the information they needed to make fair admissions decisions. While colleges could do more to support the adoption of portfolios, as will be discussed in depth in the following chapter, the perceptions of parents can significantly limit schools' and states' abilities to enforce transformation

of the system.

5.3 Directions for Policy

The primary issue for implementing authentic learning portfolios through policy lies in balancing system level pushes for the transformation while still giving schools local autonomy over their processes. School accountability requirements have historically hindered progress as strict rules and benchmarks pushed schools to prepare students for tests first and proficiency second. As the preparation of a portfolio contributes to learning, "teaching to the portfolio" would likely have positive impacts on student outcomes. Portfolios may become less engaging though if an accountability system pushes strict adherence to standards while not allowing schools to customize student experiences. With the current approach of ESSA, schools need to use their autonomy to try new assessment approaches including portfolios and performance assessment. As these endeavors will require resources many systems may not have, future policy should also include support for districts' experiments. Ambivalence to portfolios may also dampen the scaling of the portfolios, as schools may not fully buy-in with the system if it does not meet specific needs. Therefore, future policy promoting authentic learning portfolios should also require that the practices be included in school curricula, such as through graduation requirements. A mandated transformation will likely face initial push-back, yet through additional training and implementation support, the practices can overcome their initial shortcomings. The acceptance of the practice by families will determine the transformation's overall longevity, so schools will need to involve parents with implementation to ensure their needs are met. Finally, policy needs to consider how other key stakeholders impact the viability of their efforts. With colleges controlling many of the perceptions that have affected past attempts at transformation, the two stakeholder groups will likely need to coordinate efforts with K-12 education to ensure the successful scaling of the system.

Chapter 6

Securing the Support of Higher Education

As shown by the previous case studies, the acceptance of portfolios by college will do much to secure the support of other stakeholders, namely students and families. Colleges have issued statements of support to similar practices before, yet the messaging has had seemingly limited effect on perceptions of their expectations. This may partially occur since most applications still treat portfolios and similar practices as exceptions to the norm. Maker portfolios at MIT and other schools supplement the application, with most admitted students not submitting a portfolio. Over 160 colleges have accepted students using the Mastery Transcript, yet they often only receive a few as adopting high schools are still limited (Montes, 2021). Hope is not lost though, as some uses have seen larger scale, including existing use in art and design as well as the now required use in the Ross School of Business's application. Requirement is the key difference here; by mandating all students participate, the portfolio receives the proper emphasis it needs to instill further adoption by K12 systems. The question remains then: what has prevented adoption at scale of portfolios by universities? To answer this question, I sought feedback from professionals in admissions to learn how to best address the barriers their offices would face in trying to implement my proposal.

6.1 Interview Methodology

In Spring 2022, I conducted semi-structured qualitative interviews with representatives from undergraduate admissions offices over Zoom. The interviews lasted between 30 minutes and an hour. While primarily interviews occurred with one representative from each participating organization, some did include multiple representatives. Prior to starting the interview, the interviewer confirmed that participants signed a consent agreement and understood the interview would be recorded and transcribed for use in publication. Participants were told their institution's identity would be anonymized except for the details included in Table 6.1.

Participants received a one-page overview of the proposed system to read beforehand, and the interview began with another brief system description along with time to clarify any questions the representative may have had about our use of portfolios. The interview procedure focused on eliciting the representative's thoughts on the proposed system with focus on answering the research questions identified in the introduction of this paper. The interview also included questions about specific features of our portfolio to determine the extent of professional support for our design features. Interviews were recorded and transcribed by the author, and responses were grouped together by similar themes as they related to the earlier defined questions. In the next sections, these themes are discussed along with some illustrative quotes identified from the interviews.

The author contacted undergraduate admissions offices through cold emails and personal connections to recruit admissions directors and counselors to participate in the study. As these individuals both help set college's admissions procedures as well as review applications, they can provide the best insight into how their institutions would implement portfolios and the challenges they would face in doing so. Colleges were recruited to represent a variety of different institutional environments; institutional features considered when recruiting included public vs. private status, primary curricular focus, size, and selectivity indicated by Barron's Selectivity Index. Two-year institutions were excluded from recruitment as many of these colleges have the

Table 6.1: Characteristics of college sample.

College Label	College Type	Undergraduate Enrollment Size	Barron's Selectivity Index
A	Private, STEM-focus	Medium	1
B	Private, STEM-focus	Small	1
C*	Public, STEM-focus	Large	2
D*	Private, Liberal Arts	Medium	1
E	Private, STEM-focus	Medium	2

Note: * indicates more than one representative was interviewed from college

least selective or open enrollment admission processes that would not benefit nor be hindered by the implementation of portfolios. The sample for this thesis includes representatives from five four-year institutions. The participating institutions included one public institution and four private institutions. Table 6.1 shows the characteristics of each institution interviewed along with the anonymized label used to attribute quotes in the remainder of this paper.

6.1.1 Limitations

This study is limited in that the sample represents a small number of colleges that would face challenges using portfolios. Specifically, public colleges and less selective colleges are underrepresented in the interviews conducted. The sole public college interviewed (College C) indicated that their use of portfolios would be partially limited by state reporting rules which would still require standardized test scores to be considered. Other public colleges would face similar restrictions, so additional interviews should explore what limits would exist in other states to understand what policy changes would be needed to scale portfolios nationwide.

Less selective colleges, unlike the institutions interviewed in this study, often rely

on formulas based on GPA and test scores and minimum requirements to determine acceptances. As portfolios would offer a more qualitative assessment of a student, these colleges will likely face additional implementation challenges not addressed in this study. Some institutions like Iowa's public colleges have, however, begun offering alternative pathways for students not dependent on the factors they use in their admissions formula (Akin et al., 2022). Future research should then include less selective colleges to understand their requirements for the system to supplement or replace their existing formulas and cutoffs.

6.2 Perspectives on Operational Details

The interviews with college admissions professionals revealed tentative support for the proposal from an operational perspective. Admissions appeared to favor the possible applications of portfolios in their existing processes, and they indicated that the types of artifacts generated by authentic learning experiences would be preferred over submissions of tests and conventional assignments. Participants supported previously identified concerns that the proposal would be operationally hard to implement at the beginning, yet they expressed openness to aspects of the system architecture that aim to reduce the resource burden on stakeholders.

6.2.1 Possible Use Cases in Admissions

Participants viewed the proposal as valuable in three domains. First, they saw authentic learning portfolios' potential to supplement and eventually replace other evaluations of students' academic ability. College A, for example, indicated that the proposed system could "give us a prediction of how well a student is going to academically perform... the sort of cognitive, analytic skills and readiness that a student has." This perspective reflects the growing belief in admissions post-pandemic that their holistic review process could determine a student's academic preparedness independent of test scores. College B echoed this sentiment but also included that they would either be "all in or... not in" with using test scores in conjunction with the pro-

posal as the choice to include test scores could unfairly advantage certain students; whereas other participants some value in tests as an additional verifier to a student's portfolio, college B instead argued that they could complicate a review since tests scores and portfolio artifacts cannot be directly compared.

Participants also saw portfolios as valuable for determining admission to highly competitive or more niche programs. These cases were characterized as having many candidates with similarly high qualifications, thus admissions teams needed to look deeper into a student's experiences to determine whether they would offer them admission. College C specifically recognized that they could use portfolios to determine admission to their architecture and design fields as well as possibly their highly competitive computer science program:

> Probably 85 to 90% of the students who apply to us could do the work at our institution... But in some of the high demand areas [like computer science] where it really would be helpful for us to understand if these programs that a student is describing to us [are genuine]

The contemporary uses of portfolios for hiring in these fields further supports College C's observation of portfolio's potential value. For similar reasons, College A, College B, and College E also saw value in evaluating a student's STEM-related skills in action with their portfolio because many of their programs require qualities not readily captured in standardized assessments.

Finally, colleges saw value in using portfolios as a supporting structure to their existing mentorship and recruitment programs. College D expressly stated portfolios "could be helpful for any institutions who are considering any sort of early pipeline." Early recruitment pipelines have become common practice as colleges compete to attract talented students to attend their school. These programs benefit students who do not receive adequate support with college preparation in their high schools. Colleges also benefit from the programs as they can start recruiting their incoming classes earlier by engaging students younger. While admission is not guaranteed and enrollment at the host institution is often not required, recruitment programs have

shown to increase the pursuit of college in general, especially among underrepresented students. Recruitment programs also naturally fit in as part of the proposed system as they can provide students with another adult eligible to verify their submissions; with many programs starting early in high school and facilitated by one-on-one interactions between students and adult representatives from a college, early recruitment programs can support student's curation of their portfolio and better prepare them for leveraging their artifacts in applications and interviews.

6.2.2 Barriers From Resource Limitations

While participants could generally visualize how authentic learning portfolios could support their operations, hesitations still exist over whether their institutions had the capacity to implement the proposal at scale. As mentioned in an earlier chapter, most of the systems in higher education like the proposal are optional and have not been widely used by applicant pools. For the proposal to achieve its full potential, colleges will need to have capacity to adequately review portfolios from all applicants. With portfolio review taking much longer than the current 10 minutes dedicated to each application, admissions teams as currently structured will likely not be able to meet their same timelines for decisions. College C described these limitations: "when we get 50,000 applications and have a full-time staff of about 15 ... that creates limits within our world of what we're able to look at in the process." With the number of applications received growing annually, colleges cannot consider adopting the proposal until its processes are made more efficient. Admissions teams also may not have staff with the proper background to effectively evaluate artifacts, meaning the resource limitations of institutions will have implications beyond longer timelines for decision. College C specifically identified that "some of these things would probably go beyond our expertise and potentially require faculty review." While this has worked for some institutions like MIT with their currently small amount of maker portfolios, most colleges will not have the ability to convene a faculty panel capable of reviewing artifacts from the entire applicant pool. To secure support the proposed system must then consider design features which reduce the time and information burdens of using

portfolios in candidate evaluation.

My first proposal to address the college's operational concerns was to integrate artifacts into the existing application requirements, and participants generally supported this approach. Using artifacts as personal statements and evidence of a student's extracurricular activities were identified in interviews as the most reasonable requirements to supplement with portfolios. The annual reflections in particular received support for their role in an application as they may help reduce the stress many students face in preparing their personal statements (Warren, 2013). College A used interviews in their admission process, a requirement that past uses of portfolio in teacher hiring utilized to bring authentic learning portfolios into consideration; College A, however, stated they would not want to involve the portfolio in the interview so they could receive a different perspective on the student's qualities independent of their other application materials. While mostly interested in evaluating academic ability through portfolio review, all participants again expressed concern that their offices did not currently have the necessary expertise nor a robust process to follow.

I also proposed the use of an intermediary evaluator to provide a robust and expert-guided evaluation of portfolios, yet participants were more divided in whether they would use the results from a pre-assessment in their process. The process shared with the participants would require students to send their portfolio first to the intermediary for review; once evaluated by an expert in the domain relevant to an artifact, the intermediary would send a report summarizing the skills and qualities demonstrated in a portfolio that could be used to efficiently guide consideration of the artifacts during the application review. Colleges that saw this intermediary assessment as helpful indicated that the summary report would help them filter applications. Specifically, colleges described their desire for an intermediary organization that could help identify applicants prepared for an institution's general education requirements. Colleges with rigorous math requirements like A and B saw potential in using a student's authentic learning artifacts to select applicants who showed proficiency in solving quantitative and analytical problems. These schools also favored an expert-run intermediary's ability to contextualize a student's accomplishment within

a specific context. With adequate domain knowledge, intermediary reviewers could communicate better insights on the achievements represented by artifacts than the admission team could likely glean themselves. Not all colleges saw the need for an intermediary though and instead preferred to trust their own insights over those of an intermediary. Colleges D and E specifically stated they would conduct a full review of the raw portfolio even if they also received a summary report, as they felt the value of their independent review outweighed the time burden of it.

The question of trust also prevailed in the interviews with all participants. Two mindsets developed over what kind of trust the institution would need to have in the intermediary evaluation. The first mindset prioritized a trust in the process implemented; participants with this mindset included College A, who stated that they would not accept an external review without evidence to the correlations supports its results. College A specifically likened the evidence required to that which is available for the ACT and SAT. In contrast, other participants argued that they would need to trust the entity performing the evaluation. For College C, this seemingly came from their desire to receive support from domain experts in reviewing artifacts; to pass off the review to another organization, they would need to trust the expertise of it. College A expressed that trust of the entity would be particularly important for their applicants as students would likely be concerned of how their admission chances would be impacted by the evaluation. Considering all the perspectives, the organization taking on the reviewer role will need to establish itself as an expert in the domains it operates in as well as demonstrate that its summary reports effectively identify the qualifications colleges are interested in.

6.2.3 Other Features

Interviews included questions about other key features of the proposed design, with participant responses ranging from positive to indifferent. Participants shared a common acceptance of using school-affiliated adults to certify portfolio submissions. With most colleges already seeking evaluations from schools in the form of school reports and letters of recommendation, the interviewed admissions professional showed com-

fortability with deferring to the expertise of a student's teachers or mentors in appraising their qualifications. While public concern over the veracity of some materials provided by a student's recommenders has grown due to recent admissions scandals, the participants generally expressed confidence that cases of fraud were still limited and could be caught by their current processes. The security features included in the design proposal were identified as complementary to their processes and thus would not impede a college's ability to use portfolios. Finally, when AI was discussed as a possible remedy for the resource-intensive review required by portfolio, the colleges expressed mixed opinions. Whereas the colleges saw the potential value in using AI to expedite decisions, the participants also expressed concerns over how racial and gender bias present in other AI applications could impact their decision-making. Despite their hesistations though, colleges did indicate an openess to using AI similar to the what they felt towards an intermediary evaluator if a model designer could demonstrate strong evidence that their predictions provide fair result. With this in mind, AI-driven approaches to authentic learning portfolios, as well as likely any other education transformation, require additional research into the validity of their predictions before use becomes more acceptable.

6.3 Perceptions of Stakeholder Readiness

Participants' perceptions of the other stakeholders' ability to produce compelling portfolios also influenced their hesitations. Many participants specifically worried that students would not produce substantive artifacts, thus limiting the information a portfolio could provide. Many studies have shown that common application components often bias towards applicants from higher income families and more represented backgrounds (Alvero et al., 2021; Broussard, 2014; Hess, 2019; Reeves and Halikias, 2017); the college representatives interviewed believed that a student's artifacts will likely be similarly biased. With equitable evaluations being a key selling point of the transition, the perceived inequity of portfolios dampens support. Participants named two factors that contributed to their perception of inequity: availability of quality in-

struction and access to post-secondary guidance. Participants noted that differences in instruction quality between schools could make it harder for equally prepared students to demonstrate their abilities; College B, for example, compared one applicant's reflection "breaking down how they ran the math for their physics research paper" that showed mastery of applying math principles to real-world problems to another applicant's "BC Calculus homework" that lacked a similar depth. The artifact quality in cases like College B's example obscures evaluation of a student's abilities and could then contribute to the inequities underserved students face. Access to guidance in preparing their portfolio also influenced participants' perceptions as many students could have less support than their peers in deciding what constitutes a strong portfolio; as noted by College D, students may not "know what should be included, what should be highlighted." Participants' concerns again have roots in problems identified with other application components; studies have shown that personal statements similarly require intensive guidance not available to all students (Warren, 2013). Concerns over the perceived quality of portfolios have led many participants to only support the proposal if it were made a required part of the application because students with limited access to authentic learning experiences would likely produce less impressive portfolios. The requirement, while ideal for successful implementation across the education ecosystem, will likely make adoption unfavorable until the system can address these perceptions.

Perceptions of the expectations of higher-level decision makers also appeared to impact some participants' responses to the proposal. The authentic learning portfolio would provide qualitative insight into a student's qualifications, yet many of the systems colleges interact and comply with rely instead on quantitative measures like test scores and GPAs. College C, the sole publicly funded institution in my study, noted:

> There are some data elements we must provide to the university system. . . , so that even if a student has prepared a very beautiful and thorough ePortfolio and their school doesn't use more than that, we're going to need a grade point average so that they. . . can access. . . scholarship programs.

Even if a school did not have restrictions on the information they needed to collect, participants acknowledged that they would need to rethink systems like scholarship that have depended on the availability of certain quantitative data. The City University of New York pilot, which developed a way for students to use a portfolio to demonstrate preparedness when their test scores and GPA were insufficient, shows one way that colleges could do this (Fine and Pryiomka, 2020). By experimenting with alternative pathways, higher education institutions will develop expertise in translating artifacts to qualities they want in students.

Finally, the interviews revealed colleges' acceptance of the proposal will depend on how admissions offices perceive their changes will impact applicants' perceptions of what colleges expect. As seen in the previously discussed high school and policy cases, the perceptions of students and their families on what colleges look for in applicants can make or break the success of education transformations. The changes made by higher education institutions to their applications thus have massive implications to how students and families respond to transformation. The proposal leverages this by having colleges lead the push for authentic learning portfolios, but the participants interviewed seem hesitant to take this role as they feel it may cause students to experience more stress rather than less. College A used a metaphor of a grocery store to characterize their concerns. In the conventional process, the student "shops" for experiences freely, stressing about evaluation only when it comes time to apply at "checkout." The proposal instead shifts the stress of "checkout" to each time a student chooses an experience since they perceive their decision as impacting their college options as the decision is made. The decision anxiety illustrated by the grocery store analogy already widely exists; the massive college counseling industry reflects the anxiety many families currently face. The proposal, however, amplifies perceptions because applicants lock themselves into using an artifact by adding it to a portfolio whereas they could ignore it on the conventional application if they want to. Colleges will likely hesitate in employing portfolios until applicants can develop healthier perceptions of the college application process.

6.4 Next Steps for Higher Education

Colleges appear ready to adopt authentic learning portfolios in their admissions process if other primary stakeholders similarly accept. While operational details around review efficiency require additional research to resolve, experiments can begin to identify the correlations between portfolio attributes and preparedness for college. As an intermediary evaluation organization would appear to help many institutions adopt the proposal, future action should prioritize developing a robust evaluation method for either an existing or new entity to execute to support the spread of portfolios. Besides operational difficulties, colleges appear most hesitant to adopt authentic learning portfolios due to concerns that the rest of the ecosystem needs more time and resources to make the transition. The perceptions of schools and families though have been shaped by the lack of formal requirement of portfolios by colleges, and deadlock will remain until one group decides to lead the charge. With growing authentic learning offerings at the K12 level, more colleges need to consider at least optional portfolios like MIT's maker portfolio to motivate more schools to adopt the practice. As admissions teams gain comfortability reviewing portfolios, they can make the transition towards a program-specific requirement like was done at the University of Michigan. Making the step towards a requirement in college applications will give high schools and states the momentum needed to mandate the practices in K-12 schools. Until then though, colleges and K12 schools need to support each other's effort to start transformations.

Chapter 7

Conclusion

This thesis presented a system architecture that uses portfolios to encourage the much-needed adoption of authentic learning practices in American schools. Starting with some of the existing uses of the practices, key operational details were identified to be included in the final design of the system. In developing the design, problems arose that could not be resolved through an operational strategy. Instead, these challenges came from the complex relationships between the system's stakeholders, and thus, their resolution required further investigation into what assurance they needed to ensure their cooperation. Restrictive policies appeared to create some of the hardest barriers to overcome, yet fortunately, momentum towards an education ecosystem more favorable to authentic learning portfolios has appeared to have grown. Policy alone, however, cannot guarantee the transformation. The relationship between students and their opportunities after graduation can also pose a significant hindrance to portfolio's implementation. Conflict between a student's perception that colleges will not accept anything other than test scores and a transcript and the reality that colleges see no problem with using an alternative has impeded efforts by schools to make the transition. Contrarily, colleges have hesitated in considering authentic learning portfolios more widely due to their own misconceptions that students will have the ability to produce a useful collection of artifacts. The strategy to spread portfolios must then consider how to address these concerns to ensure the support needed from

all stakeholders. To conclude this thesis, I summarize some of the major changes, motivated by my investigations into the specific needs of the key stakeholders, to my initial system architecture and provide some final recommendations for future efforts attempting to bring the proposal to fruition.

7.1 Changes to the System Architecture

In considering what stakeholders would need to ease the transition towards portfolios, I identified necessary changes to the authority of stakeholders that would require an adjustment to my initial stakeholder salience map. One needed change should be shifting parents and families from being a "Dangerous" stakeholder to a "Definitive" one in Mitchell's salience model by providing them with more legitimacy in the decision-making process (Mitchell et al., 1997). With their support critical to whether students will take portfolios seriously, their views towards the practice need to be better included in the system. Parents and families can indirectly control the governance of their schools through their vote, yet a transformation like authentic learning portfolios could benefit from more formal guidance from parents on what they would like included in the system. Other changes to the salience of stakeholders include increasing the urgency that colleges and employers have towards transformations in K-12 education. These stakeholders contribute to parents' perceptions of what schools should teach, so by not including their perspectives, mismatch occurs between what parents believe should be taught and what life after graduation requires. More urgent college and employer stakeholders will contribute their perspectives to discussions over the directions of schools more readily. Changing the salience of stakeholders will ultimately make it easier for each to participate in the strategic capacity they need to.

The initial system architecture proposed in this thesis assumed that portfolios could be implemented before authentic learning, yet colleges challenged this timeline as it could put students from resource-limited schools at a larger disadvantage. The artifacts from the conventional classroom have little comparable value to those pro-

duced by authentic learning. With artifacts making up the primary information used by the enterprise, inequity here greatly diminishes the benefits the system could provide the larger ecosystem. Access to authentic learning experiences and the artifacts that they create should take even larger priority in creating the system. Fortunately, the knowledge generated by the enterprise can help expand access if distributed properly. The local successes that currently exist for the proposal illustrate the kind of knowledge the enterprise will accumulate. With the proper knowledge-sharing infrastructure, schools looking to implement more authentic learning experiences can search out peers that have found success with the practice. To better facilitate knowledge sharing, additional infrastructure will need to be developed, preferably leveraging Open Educational Resources to ensure that all schools can have equitable access to the enterprise's knowledge base.

The last change to initial architecture proposed also relates to the infrastructure supporting the enterprise, specifically how the system handles the different expectations of different disciplines. Currently, many platforms exist to host portfolios, and schools have freedom to choose an approach that works best for their context. Similarly, disciplines will have different expectations of what a portfolio includes, so a variety of portfolio options would need to be supported. However, as focus shifts towards the needs of colleges and employers, uniformity becomes more preferred. College applications, for example, typically include the same components. Platforms like the Common Application have particularly succeeded because they made it easier for students to submit applications to different colleges with similar admissions requirements. Colleges as well as employers would want similar uniformity in the portfolio they choose to accept. In deciding on a preferred infrastructure for the enterprise then, priority should be given to choosing a common platform to host the portfolio yet continue to offer multiple options through which a portfolio can be reviewed. Intermediary organizations would facilitate these offerings, while an independent group could handle the hosting operations. Intermediary organizations would likely support the push for a common platform as it would assist their evaluations as well.

7.2 Action Plan

Implementation of authentic learning portfolios will not be immediate. A consensus over best practices needs to be achieved. Processes and infrastructure need developing. Stakeholders need reassurance that the transformation will not significantly disrupt their operations. All these efforts will require external pressure to provoke stakeholders into acting. The final goal of this thesis is to provide advocates of authentic learning portfolios with a blueprint for how to implement the system. The previously defined system contributes to this goal by detailing how the enterprise should organize, but as a novel project, components will need to be built from the ground up. The remainder of this conclusion delineates the next steps that advocates will need to execute to begin the transformation.

7.2.1 Implement Practice-Friendly Policies

The current ecosystem has qualities that have led to local successes of authentic learning portfolios, yet in general, some features of the system still need to change to make scaling easier across different communities. Policy over time has contributed to more local input regarding assessments. However, the risks of failure and high costs of innovating discourages many communities from straying too far from the status quo. The environment can be made more conducive to implementing portfolios by at first encouraging and later mandating schools adopt the practice. Encouragement goes beyond giving schools the authority to try alternatives by removing other obligations that have historically pulled attention away from portfolios. Schools with less obligations to comply with, and thus competing expectations around things like testing, can then explore how portfolios will support instruction. Even then, schools will hesitate to make changes that anger families. Advocates for authentic learning portfolios should then be ready to challenge opposition by demonstrating the success of portfolios in action. While this may require unpopular interventions that overrule local autonomy, change will not occur until entities take the initial jump. Require-

ments need not completely disrupt the status quo, but pushes for schools to at least try the practice will contribute to the eventual success of the proposal.

7.2.2 Start Experiments to Refine Design

The local successes of authentic learning portfolios show that transformation can happen in the right circumstances, yet to understand what must be done to adapt the system to different environments, more entities must try out their own implementations. This may cause the most difficulty for expanding the practice as no organization wants to implement a system that could fail, especially if its peers are also not onboard. Unlike other social experiments in which the subject can return to their status quo relatively quickly after treatment, students only have one education that they likely would not want to risk on a transformation with uncertain outcomes. To address this, initial implementations of authentic learning portfolios should not completely replace convention. In high schools, this means preparing a portfolio in parallel to taking standardized tests and achieving a traditional GPA. For colleges, this means first including portfolios as an optional component. The purpose of these first stages is to build familiarity with the practice and finding correlations between artifacts and the traditional measures of achievement. As organizations learn how to support the practice, experiments should shift towards confirming what role portfolios should take in processes. Use should remain optional when it comes to decision making processes, yet the development of a portfolio should begin to take priority to the other measures. At this stage, all students should have portfolios they could reasonably use post-graduation, but ultimately, they retain the ability to not submit it if they so wish. This may require colleges to consider portfolio submitters and non-submitters separately, much like many current admissions offices have implemented test-optional policies. High schools and the families that they serve will become more comfortable with using portfolios in assessments, and thus, they will trust the evaluation methods they helped develop through the participation in the pilots. Increased comfortability will lead to portfolios becoming the new normal, and experiments can then become permanent fixtures in the system.

7.2.3 Form Evaluation Organizations

To ensure colleges and other users of students' portfolios have all the support they need, intermediary organizations need to form with the purpose of developing review processes useful to the key stakeholders. While some of the college representatives interviewed expressed ambivalence to the potential outputs of these organizations, the general need for efficient processing of portfolios make intermediary organizations an important part of the system implementation. Considering how varied portfolios will be between different disciplines and levels of a student's development, evaluations will likely need to be adjusted for each context, thus making multiple organizations with different areas of expertise necessary. Each intermediary organization could be supported by a different group of experts, and their process can be designed to identify the key qualities unique to success in each field. The evaluation cannot be too specific though either, as students will still need leeway as they continue to refine their career goals. As for who can support the development of these organizations, existing entities which people already trust as experts within their specific domains should be preferred to starting new ones; this would limit much of the start-up costs of the enterprises by utilizing existing infrastructure to recruit reviewers. A general evaluator could, for example, be administered by the College Board who already recruits many teachers as evaluators for the AP programs. As more domain-specific evaluators become required, organizations could follow two existing blueprints. First, colleges focused on a specific field could come together like arts and design schools did to develop the National Portfolio Day and create review criteria acceptable for their purposes. By directly involving the end users of portfolios in the process design, the intermediary organization can ensure their reports provide value to its users. Second, existing associations of domain experts, such as the National Academies for STEM fields, could support the enterprise; these groups of experts have both the background knowledge to understand students' artifacts as well as lived experience they can contribute to help determine what qualities were most important for success in their fields. AI tools could eventually reduce the human resources required to operate an

evaluation organization, but the models employed will likely first require extensive testing to gather the support of stakeholders. Many hesitations over the fairness of algorithms still exist among stakeholders. For AI to overcome these concerns, developers will need to demonstrate that their models can produce accurate predictions not biased by features unrelated to a student's qualifications. As developers will require a large amount of sample portfolios with corresponding evaluations to train a model, deployment of AI will likely need to wait until stakeholders have confidence in the human-driven evaluations of portfolios. The above described experiments in implementing the practices are thus necessary to make an intermediary organization feasible.

7.2.4 Educate Stakeholders

As seen throughout my inquiries into stakeholders' needs, the importance of addressing misconceptions about the practice became apparent. In looking at how schools and other organizations currently implement practices, often groups have taken shortcuts that undercut the practices' benefits for learning. Schools must understand that authentic learning portfolios require more than replacing a test with a project or requiring students to store past work in a folder. The non-cognitive development derived from the practices can only occur when the expectations of students change. Again, engagement should be the goal. The changes required will challenge the existing beliefs that the system has around learning as these mindsets have shown themselves to be insufficient in addressing the issues that the educational ecosystem currently faces. Considering the challenges faced by school transformations in the past, these radical changes will attract opposition comfortable with how things have always been done. The opposition is not wrong in their beliefs, as for some, the status quo will continue to be the best option. Authentic learning portfolios will just expand the range of options that a student has in deciding how they best learn. Stakeholders will need to be convinced of this for the proposal to succeed. Fortunately, the same skills reinforced by authentic learning portfolios can help inform stakeholders of why the transformation is necessary. Much like a portfolio helps a student understand

how their artifacts relate to their interests, those who take lead of the transformation can find connections between the benefits of the proposal and the needs of actors in the system. This thesis furthers an ever-present conversation of how we can design a system that not only accommodates learners' differences but embraces and leverages them to improve instruction for all. Each stakeholder has a role to play in fixing the system, and this and future work will help move K-12 education closer to best preparing our nation's future leaders.

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