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Lesson Planning and Teaching with Asset-Based Pedagogies in a Secondary Mathematics
Classroom

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ABSTRACT

The study presented here examined the use of asset-based pedagogies in a secondary mathematics classroom. Asset-based pedagogies, as defined by López (2017), value the cultures of students in the classroom instead of viewing them as deficits. The research goals of the study were to document the creation of a secondary mathematics unit utilizing asset-based pedagogies, to explore teacher and student's perceptions of implementation of asset-based pedagogies and to identify if students' views of mathematics shifted after the implementation of asset-based pedagogies. A collection of student surveys, asset-based pedagogy rubrics, and student journals were collected to make observations about students' perceptions of teacher implementation of asset-based pedagogies. A teacher journal was also collected to provide insight into the teacher's perceptions of the implementation and development of asset-based pedagogies. Open coding and constant comparative methods (Corbin & Strauss, 2008) were used to find emerging themes in the data. Although the findings did not provide significant results in terms of the research questions, they provide important implications for further studies and recommendation for novice teachers trying to incorporate asset-based pedagogies in the classroom.

TABLE OF CONTENTS

LIST OF TABLES	iii
ACKNOWLEDGEMENTS	iv
Introduction.....	1
Literature Review.....	4
Asset-Based Pedagogy.....	4
Student Identity and Asset-Based Pedagogy.....	10
Students’ Mathematical Identity and Asset-Based Pedagogy.....	12
Implementation of Asset-Based Pedagogy in Mathematics.....	13
Methods.....	16
Settings and Participants	16
Data Collection.....	17
Teacher Journal	17
ABP Rubrics and Student Surveys.....	18
Student Journals	20
Data Analysis	20
Findings.....	23
Development and Implementation of ABP	23
Planning of ABP.....	25
Implementation of ABP	26
Students’ Perceptions of Implementation of ABP	29
Critical Awareness	31
Cultural Knowledge	34
Cultural Knowledge Integration.....	36
Teacher Expectancies.....	37
Students’ Perceptions of Mathematics Post ABP Implementation	38
Discussion.....	42
Development and Implementation of ABP.....	42
Students’ Perceptions of Implementation of ABP	44
Students’ Perceptions of Mathematics Post ABP Implementation	47
Conclusion	49
Appendix A Student ABP Rubric	51
Appendix B Mentor and Supervisor ABP Rubric.....	52

LIST OF TABLES

Table 1 <i>Participation of Participants</i>	16
Table 2 <i>Teacher Journal Questions</i>	18
Table 3 <i>Student Survey Questions</i>	19
Table 4 <i>Student Journal Questions</i>	20
Table 5 <i>ABP Rubric Choices</i>	29
Table 6 <i>Student ABP Responses</i>	30
Table 7 <i>Student Journal Responses: How would you describe a math class to someone who had never experienced it?</i>	39
Table 8 <i>Student Journal Responses: When do you use mathematics outside of school?</i>	41

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Introduction

Asset-based views on education shift the classroom culture away from deficit-based thinking in terms of students' differences. This shift creates a classroom environment that values all students' experiences and challenges the typical classroom norms. Teachers play a significant role in how students' cultural and personal experiences are utilized and viewed in the classroom. One particular way in which teachers can begin to create these positive asset-based environments is through the use of asset-based pedagogy. The foundation of asset-based pedagogy (ABP) was described and theorized by López (2017). López (2017) studied the relationships between teachers' ABP beliefs and behaviors and Latino¹ students' identity and achievement. Studying the use of ABP is important in order for teachers to understand the effects of viewing students' cultures and interests as valuable within the classroom. It is also important for educators to understand ABP to help them know when, how, and to what extent ABP should be utilized.

The current research study focuses on understanding the use of ABP and its effects within a secondary school setting with a focus in mathematics. The research study has three main purposes. The first purpose is to document the creation of a school mathematics unit utilizing asset-based pedagogies in a secondary school setting. The second purpose of the study is to explore a teacher's perceptions of ABP implementation along with her students' perceptions of the ABP experiences. Studying teacher and student perceptions will provide insight into similarities and differences between how a teacher plans to use ABP, how a teacher implements

¹ Latino was chosen here to be consistent with the reports of Lopez (2017). This decision is a difficult one in terms of consistence and goal of being gender and identity inclusive; therefore, I've chosen to note the specific reasoning of my choice in language.

ABP, and how students perceive the teachers use of ABP. The last purpose of the research study is to identify whether the implementation of ABP changes how students experience mathematics and how they view their relationship with mathematics. The research questions answered in this study are:

- What are the teacher's experiences in developing and implementing lessons incorporating asset-based pedagogy in a secondary mathematics algebra I unit?
- What are algebra I students' perceptions of their teacher's implementation of asset-based pedagogy?
- How do the mathematics perceptions held by students who experience a secondary school algebra I unit taught using asset-based pedagogies change after the unit delivery?

The main forms of data collected during this study include teacher journals, rubrics created to score factors of ABP, student surveys, and student journals. The ABP rubrics were analyzed using open coding and constant comparative method (Corbin & Strauss, 2008) to identify themes that emerge. Codes for each of the four areas of ABP (critical awareness, cultural knowledge, cultural content integration, teacher expectancies) were used to organize the themes. The student surveys were analyzed using pairwise comparison to identify the differences between each student's set of responses and to evaluate the changes between a student's first survey response and second survey response. To analyze student and teacher journal responses, open coding and constant comparative method were used to identify themes in students' mathematical perceptions and teacher's perceptions of the development and implementation of ABP. The data collected from the various data sources will provide insight into the planning, teaching, and learning of mathematics utilizing ABP along with how students perceived math before and after the implementation of ABP.

This paper will first explore the literature on ABP, the connection between students' identity and ABP, and the connection between students' mathematical identity and ABP. After a review of the literature the methods for the study are described and an analysis is provided. The analysis is followed by a discussion and implications of the study.

Literature Review

Asset-Based Pedagogy

Asset-based pedagogy is an area of interests within education which focuses on creating classroom spaces that promote student differences. Asset-based pedagogy (ABP) is defined by López as a pedagogy “that views students’ culture as a strength, countering the more widespread view that inordinate achievement disparities stem from deficiencies in the child and/or child’s culture” (2018, p.66). In other words, parts of children’s lives that are often seen as deficits in education specifically in marginalized students are shifted through the use of ABP to be valued in the classroom as assets. Some of these assets include students’ home and heritage culture and native language (López, 2018,).

Asset-based pedagogies take form in many different ways and are known by several different names. One of the earliest pedagogies discussed in the literature was multicultural education. Banks (1993) described the dimensions of multicultural education as content integration, knowledge construction, prejudice reduction, equity pedagogy, and empowering school culture. Multicultural education aimed to reform the school and education institutions to promote educational equity in terms of race, ethnicity, socio-economic status, and gender (Banks, 1993). Another form of asset-based pedagogies is culturally relevant pedagogy which was termed by Ladson-Billings (1995). Culturally relevant pedagogy is a theoretical model to address student achievement while affirming their cultural identity and developing critical perspectives to challenge inequities (Ladson-Billings, 1995). Culturally responsive pedagogy, another asset-based pedagogy, aims to improve student achievement “by teaching diverse students through their own cultural filters” (Gay, 2013, p.50). Its aims are to connect students’

school experiences with their out-of-school experiences, promote education equity and excellence, and create a community of diverse individuals (Gay, 2013).

Some newer asset-based pedagogies are culturally sustaining pedagogy and culturally sustaining/revitalizing pedagogy. Culturally sustaining pedagogy is termed by Paris (2012) and adds to the existing research by stating that pedagogies should support students' in "sustaining the cultural and linguistic competence of their communities while simultaneously offering access to dominant cultural competences" (p.95). Culturally sustaining/revitalizing pedagogy is "an approach designed to address the sociohistorical and contemporary contexts of Native American schooling" (McCarty & Lee, 2014, p.103). Culturally sustaining/revitalizing pedagogy consists of three components (McCarty & Lee, 2014, p. 103):

- (a) Attends directly to asymmetrical power relations and the goal of transforming legacies of colonization.
- (b) Recognizes the need to reclaim and revitalize what has been disrupted and displaced by colonization.
- (c) Recognizes the need for community-based accountability.

López (2017) utilize ABP as a framework to study a specific group of students and theorizes it with similar features as those previously described in the literature with an updated focus. This focus is on the link between teachers' beliefs and behaviors and student outcomes (López, 2017). I chose to focus on López's framework as it incorporates key components of prior asset-based pedagogies while offering a new perspective. Thus, the remainder of the review in this section focuses on essential information about the framework provided by López.

Successful ABP implementation requires prerequisite knowledge from the teacher in several different aspects. López calls these critical awareness, cultural knowledge, and cultural content integration (2017). López (2017) claims that:

Teachers who possess an understanding of the sociohistorical influences on traditional marginalized students' trajectories (*critical awareness*) are better able to cultivate students' knowledge by building on their prior knowledge (*cultural knowledge*) and incorporating knowledge that validates students' experiences (*cultural content integration*) into their instruction (p.193).

Thus, teachers must have strong critical awareness, cultural knowledge, and the ability to integrate culture into content. Critical awareness is the knowledge of historically marginalized students' history and culture along with the knowledge of how schools and curriculum maintain biases and the social power structure (López, 2017). López describes how the lack of teacher understanding in critical awareness leads to assimilation and deficit-based views because teachers view the norms of the school as acceptable which further perpetuates the school biases and social power structure (2017). If teachers have low critical awareness, then they will not have the foundation needed to successfully implement the remaining components of ABP in their classrooms.

López (2017) emphasizes that teachers who have a better critical awareness are able to utilize their students' cultural knowledge to help better implement their students' culture and ultimately ABP into the classroom. Empathetic care is described in the literature as one way to build the understanding that López discusses in the definition of critical awareness. Empathetic care is defined as "a teacher's authentic expression of identifying with the challenges of their students and prioritizing students' well-being above their own" (Maloney & Matthews, 2020,

p.408). Maloney & Matthews (2020) found that teachers who expressed empathetic care for their students had awareness of the impact systemic inequity has on the surrounding community of the school and on students' personal and academic experiences. Thus, by building this type of care and these relationships with students, teachers are able to build the skills López (2017) deems essential for planning and implementing ABP.

Another way to build a stronger foundation for ABP implementation is to continuously check our beliefs and biases. Gay (2010) recommends questions that we should always be asking as teachers to help positively shape our pedagogy. These questions are:

What do prospective teachers believe about the underlying causes of the differences among their ethnically diverse students, and between themselves and their students? Do they think critically about these issues at all? Are they able and willing to articulate their attitudes and beliefs about cultural diversity and to change their attitudes and beliefs to produce more positive ones? Can they recognize specific beliefs embedded in particular teaching decisions and behaviors? Which prospective teachers hold what beliefs about which particular groups of color and why?

By asking questions such as these teachers could begin to shape the way they view their students' differences helping teachers to see those differences as assets instead of deficits. This shift would build a better understanding of students, building critical awareness, along successful implementation of ABP.

While critical awareness is essential, so is teachers' cultural knowledge and the capability to integrate this knowledge into the content. When teachers possess and use cultural knowledge, they view students' cultures as assets and they actively use students' prior knowledge of their culture within the classroom (López, 2017). When a teacher begins to develop a deep

understanding of their students' culture, background, and interests they are able to better integrate those aspects into the mathematics. Basu & Greenstein (2019) explain one way to gain knowledge of students' interests, culture, and home knowledge along with their mathematical knowledge. They describe an activity in which students are asked "would you rather" questions and then asked to explain their choices, which elicited mathematical and personal explanations (Basu & Greenstein, 2019). They found that they were able to elicit a better understanding of mathematical knowledge in terms of fractions, rates, ratios, and area along with information about how students travel to school, their beliefs about sharing with friends and family, food preferences, and concerns about money (Basu & Greenstein, 2019).

Once an understanding of students' cultural knowledge begins to develop, better integration of culture and student interests can be integrated into the mathematics (López, 2017). Incorporating social justice into the classroom provides an opportunity for teachers to integrate meaningful topics into the mathematics that connect to students' culture and identity. The integration of social justice can help show students how to use mathematics to become agents of change in areas that are important to them. One study (Leonard, Brooks, Barnes-Johnson, & Berry, 2010) explains four ways teachers integrated culturally relevant pedagogy and social justice pedagogy in the math classroom. The examples include (a) problem solving and the Underground Railroad; (b) algebra and the displacement model; (c) geometry, recourse allocation, and South-Central LA; and calculus and (d) the distribution of wealth (Leonard, Brooks, Barnes-Johnson, & Berry, 2010). In other studies teachers used their understanding of the community and their students to connect mathematics to limited food access (Harper, 2019), basketball and dominoes (Nasir & McKinney de Royston, 2016), and the #BlackLives Matter movement (Chao & Marlowe, 2019). Each classroom presents a unique group of students with

opportunities to connect their lives with math. Once teachers become more fluent in their students' culture and interests, the integration of ABP can become smoother and more meaningful.

The intersection between critical awareness, cultural knowledge, and cultural integration is important. These three forms of knowledge should not be viewed as silos; instead, when pieced together an interesting student-teacher dynamic is developed. Students' values are able to be shown to the teacher, and teachers are able to show students that student culture is valued through the lens of specific content.

López (2017) also discusses teacher expectancy and teacher effectiveness when describing ABP and its implications. Teacher expectancy typically has a larger impact on marginalized students and is defined as what a teacher expects from students via performance (López, 2017). Teacher effectiveness is described as how a teacher's behavior influences student outcomes (López, 2017). Appropriate teacher expectancies and strong teacher effectiveness can result in positive results when ABP is used which can ultimately provide a better growing and learning environment for students. For this reason, teachers need to be aware of the relationship between their expectancies and critical awareness for their students' cultures and how this aligns with their behaviors.

ABP is shown to promote student identity development which results in better achievement outcomes for these students (López, 2017). ABP promotes student identity because it recognizes and allows students to see others value their culture which can affect the way a student perceives the value of their culture and themselves (López, 2017). López (2017) defines one type of identity called achievement identity. Achievement identity is how a student perceives their ability in an achievement setting which can be impacted by teacher beliefs and behavior

(López, 2017). Focusing on achievement identity and overall identity is important when teachers implement ABP because successful implementation promotes parts of these identities as the assets in their classroom.

Student Identity and Asset-Based Pedagogy

Since ABP is shown to promote students' cultural identities and increase academic achievement within a classroom setting, it is important to explore the relationships between identity, culture, and academic achievement. Identity can be defined by how a person answers questions such as, "Who am I? What am I about? What is my place in my social group? What is important to me? What do I value? What do I want to do with my life?" (Eccles, 2009, p.78).

When identity is referred to in the remaining sections of this thesis, it is referring to the definition provided by Eccles (2009). Caraballo (2019) explains that when any aspect of a students' culture that aligns with their identity does not match the culture that is accepted at school then a student may have mixed feelings about school even if they have high levels of academic achievement (Caraballo, 2019).

The identity students form in a classroom context is what Carballo calls an academic identity which is defined by a student's position in an academic context and experience with curriculum in the classroom (Caballo, 2019). Although there is a slight difference from what López described as a students' achievement identity which is how a student perceives their ability in an achievement setting (López, 2017), both authors emphasize that a student will build an identity around how a classroom, course content, and achievement are portrayed by a teacher and the school. Caballo describes how the ability to use or not to use home language can shape a students' academic identity and cause students to form multiple identities (2019). When students

create these multiple identities and see that there are contradictions between their home and academic identities, this disconnect can lead to problems with how students view themselves and their relationship to school (Caballo, 2019). López (2017) identified similar findings related to language and culture, but also discussed how ABP can influence these multiple identities in a positive way.

It is important to view the connection between aspects of ABP and how these aspects can create an atmosphere for positive student academic identity development. Deficit-based thinking about marginalized students' achievement in academic settings stems from the traditional views of equity, effort, and colorblindness (Caballo, 2019). However, ABP values the culture of all students (López, 2019), which limits normalizing white and middle-class standards (Caballo, 2019). The implementation of ABP also refrains from positioning “the cultural literacies and identities associated with some minoritized students as incompatible with an academic context” (Caballo, 2019, p.1308). Thus, the shift from deficit to asset-based thinking in a classroom context is essential in helping breakdown the negative stereotypes of marginalized students while allowing them to create in school identities that align with their home identities.

Nasir & McKinney de Royston (2013) describe how social and cultural capital can position a student in school perpetrating social order and acceptance. Social and cultural capital are types of funds of knowledge that a student possesses. Funds of knowledge is described by Moll, Amanti, Neff, & González (2005) as “historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being” (p.72-73). A more recent definition is provided by Wilson-Lopez, Mejia, Hasbún, and Kasun (2016) as “intergenerational, accumulated from workplace and household management skills that have been handed down from grandparents and great-grandparents” (p. 280). Through the use of

ABP students' funds of knowledge differences can be viewed as assets instead of deficits.

“Valuing these various forms of capital allows us to examine the diverse resources and types of day-to-day activities that individual actors draw upon to resist the patterns and practices of social stratification” (Nasir & McKinney de Royston, 2013, p. 268). For example, valuing students home language and allowing them to speak their home language in a mathematics classroom provides them a sense of power they may not feel if this part of their identity is not welcomed in the classroom setting (Oppland-Cordell & Martin, 2014).

Students' Mathematical Identity and Asset-Based Pedagogy

Identity formation is strongly influenced by the decisions a teacher makes and is positively affected by asset-based views (Caballo, 2019; López, 2017). Thus, when studying identity and ABP in a specific context, such as mathematics, it is important to look at how students form identities within the mathematics classroom and content.

It is a teacher's role to recognize the funds of knowledge not valued in school that could be valued in the mathematics classroom thus, teachers need to connect the unconnected (Nasir & McKinney de Royston, 2013). There are two important aspects of ABP that are essential for a teacher to focus on when trying to value students' funds of knowledge. Those aspects are cultural integration into content and teacher effectiveness (López, 2017).

Teacher effectiveness is important for a teacher to evaluate because the behavior a teacher chooses to use impacts their effectiveness and ultimately influences students' mathematical identity development. Gholson & Martin (2019) found that when a teacher used “mathematical micro-corrections” (p. 401) students began to require constant affirmations leading to the lack of individualized thinking and greater overall pain in doing mathematics. This

teacher behavior influenced the way marginalized students, specifically a black female student, expressed themselves while doing mathematics, which impacted mathematical identities and caused distress and pain towards the subject matter (Gholson & Martin, 2019).

Teachers also can influence cultural integration into content in order to successfully implement ABP and help student form a positive mathematical identity. Teachers have the ability to bridge the gap between home and school by helping “students reflect on the types of mathematical knowledge they engage in outside school and on why only certain types of mathematical thinking and practices are valued in school” (Nasir & McKinney de Royston, 2013, p.284). This allows students to participate in mathematics in school that they already engage in outside school within their home cultures and identities. With this type of cultural integration, students are able to position themselves positively in mathematics classrooms while positioning themselves as more knowledgeable since their funds of knowledge are now a valuable addition to the context (Langer-Osuna, 2007). When students see their differences and the differences of others as assets, they learn how these assets are valuable resources, allowing stronger engagement with mathematics, and view themselves as doers of mathematics (Oppland-Cordell & Martin, 2014). Once students see themselves as doers of mathematics, they enjoy and become comfortable with mathematics while also finding success in the content area (Oppland-Cordell & Martin, 2014).

Implementation of Asset-Based Pedagogy in Mathematics

The literature is consistent about how the effect of ABP can influence student identity, mathematical identity, and overall student achievement (Caraballo, 2019; López, 2017; Nasir & McKinney de Royston, 2013). Therefore, it is important to use the literature to understand how

ABP has been implemented to help provide teachers the resources they need to begin implementing ABP within their classroom content.

One example of using ABP in mathematics is provided by Gutstein (2003). He structured his mathematics classroom by integrating social justice into the mathematics curriculum. Yeh & Otis (2019) describe what is called the hidden curriculum, which in this case is curriculum that maintains the systemic power structures and privilege. However, working toward social justice in the mathematics classroom is just one example of how students can begin to understand these inequities and the “sociopolitical dynamics of their world” (Gutstein, 2003, p.39).

Some questions that Gutstein asked in his classroom were: “Why are there so many gangs in your neighborhood, and why are so many bright and talented students dropping out and joining them? Why is the complexion of your neighborhood changing and what’s behind those changes?” (2003, p.40). By asking these questions students were able to develop an understanding of systemic power relations and their role in it using mathematics (Gutstein, 2003). Thus, students were able to see themselves within the mathematics and were given the power to be agents of change through the doing of mathematics (Gutstein, 2003).

Rubel & McCloskey (2019) offer a strategy for using cultural integration within the mathematics classroom that can help teachers better implement and gain support for ABP. ABP and examples like those provided in Gutstein (2003) can raise questions by administration such as “Where’s the math? (Rubel & McCloskey, 2019). This question is problematic and reinstates the idea that there is one correct way to do mathematics which is typically the one that is taught in schools (Rubel & McCloskey, 2019). However, every culture has its own way of doing mathematics that is seen as valid and are respected in the field; therefore, these ways of doing mathematics should be taught and valued (Rubel & McCloskey, 2019). Teaching culturally

diverse ways of doing mathematics can be a valuable ABP tool and can help students see themselves as doers of mathematics. When marginalized students see themselves in the history of mathematics and in the different forms of it, they are able to break down the over-privileging of mathematics and develop a positive mathematical identity that can be used to achieve equity and social justice (Rubel & McCloskey, 2019).

Gutstein notes, “How students construct meaning depends much on the teacher’s pedagogy and on the classroom, environment co-created by the teacher and the students” (2003, p. 48). This idea reemphasizes the value a teacher has in implementing ABP and how this can affect students’ development of mathematical content, identities, and mathematical identities. By valuing students’ differences as assets to the classroom, students are given mathematics power (Gutstein, 2003) that helps them develop themselves as doers of mathematics (Oppland-Cordell & Martin, 2014) that allow them to develop their identities (López, 2019) and become agents of change.

Methods

Settings and Participants

This study took place in an urban school outside a major city in the northeastern part of the United States. The students were in an algebra 1 class which consisted mostly of ninth graders with a select few older students. Via the consent process, a total of nine students and their parents consented to the study. The study number of the students who participated and the total number of participants in each data collection for each method can be found in Table 1. My mentor teacher and supervisor also consented to participating in the study. These participants and the data collected from myself makes a total of twelve participants.

Table 1 *Participation of Participants*

Student Study Number	Initial ABP Rubric	Mid ABP Rubric	Final ABP Rubric	Initial Survey	Final Survey	Initial Journal Entry	Final Journal Entry
1	✓		✓	✓	✓	✓	
3	✓			✓		✓	
4	✓	✓		✓	✓		
5	✓	✓		✓	✓	✓	✓
6	✓	✓	✓	✓	✓	✓	
14	✓	✓	✓	✓	✓	✓	✓
17		✓	✓		✓		✓
23	✓	✓	✓	✓	✓	✓	✓
24	✓	✓		✓	✓	✓	

The unit of focus for this study was equations. Students were learning how to solve one-step, two-step, and multi-step equations. Students also learned concepts such as additive inverse multiplicative inverse, and like terms. The unit lasted approximately two weeks.

Due to the pandemic, the learning environment was different than a typical school year affecting my ability to fully implement ABP, gather consent from my students, and interact with my students to better understand their cultures and interests. On Monday and Wednesday, I saw approximately one-third of my students in person and on Tuesday and Thursday I saw a different one-third. One these four days those students not in school participated in learning from home remotely and on Friday everyone learned from home. Approximately one-third of my students learned at home five days a week meaning that I had never met or seen them throughout my time student teaching.

Data Collection

Teacher Journal

The teacher journal had two purposes throughout the study. First, the teacher journal was used to document the process of developing lessons within a mathematical unit using ABP. During this process, I journaled after each of my planning sessions and answered the questions found in the top half of Table 2. The teacher journal was also used to document my perceptions during my implementation of ABP lessons. After each lesson was taught, I would reflect on how the lesson went with a focus on each aspect of ABP. I would answer the questions found in lower half of Table 2.

Table 2 *Teacher Journal Questions*

Teacher Journal Phase	Guiding Questions
Development Phase	<ul style="list-style-type: none"> - What steps were taken to increase critical awareness for the lesson? <ul style="list-style-type: none"> o What resources were used? - How and where was students' cultural knowledge integrated into the lesson? <ul style="list-style-type: none"> o What resources were used? - What difficulties were faced while integrating cultural knowledge? - What aspects of cultural integration were easier to incorporate compared to others? - Where are teacher expectancies integrated into the lessons? - How were teacher expectancies determined?
Implementation Phase	<ul style="list-style-type: none"> - To what extent did the teacher show critical awareness in the lesson? <ul style="list-style-type: none"> o Where was critical awareness strong? Where was it weak? - To what extent was cultural knowledge integrated as planned? <ul style="list-style-type: none"> o What effected the extent of the integration? - How were teacher expectancies addressed in the lesson? - To what extent were teacher expectancies conveyed as planned?

Most of the planning for this unit was done over one weekend given the pace of the curriculum; therefore, there was only one teacher journal entry recorded to answer the pre-unit planning questions. While the unit was being taught, a teacher journal was recorded after each lesson. After the unit there were a total of fifteen journal entries that were recorded and used for data analysis, one before and fourteen during.

ABP Rubrics and Student Surveys

A rubric was created to document the perceptions of critical awareness, cultural knowledge, and cultural content integration using the definitions provided by López (2017).

Rubrics were completed by the students, three times throughout the study and two times by the mentor teacher and supervisor. Rubrics were completed on day 1, halfway through the unit, and after the unit was over for the students, and on the first and last day for the mentor and supervisor. A blank copy of the student rubric can be found in Appendix A and the mentor and supervisor rubric form can be found in Appendix B.

Student surveys were collected two times to provide documentation on students' feelings about teacher critical awareness, cultural knowledge, cultural content integration, and expectancies. I created these surveys based on the four components of ABP (critical awareness, cultural knowledge, cultural content integration, teacher expectancies). The surveys were taken on the first day of the unit and after the completion of the unit. Both surveys consisted of the same nine questions found in Table 3. Eight questions used a Likert scale with five options ranging from strongly disagree to strongly agree. Question seven in Table 3 was a multiple-choice question with five options to fill in the blanks which are provided next to the question in the Table 3.

Table 3 *Student Survey Questions*

Student Survey Questions
1. My teacher understands my history and culture.
2. My teacher understands the biases within the school and curriculum.
3. My teacher views my culture as valuable in the classroom.
4. My teacher views my interests as valuable in the classroom.
5. My teacher integrates culture into the course content.
6. My teacher integrates content into the course that is meaningful to me.
7. My teacher has _____ expectations for me. (very high/ high/ moderate/ low/ very low/ no)
8. My teacher's expectations align with my personal expectations.
9. My teacher's expectations are fair.

Student Journals

Each student was provided a space to use as their math journal to reflect on their perceptions of mathematics and how they see themselves using mathematics. Students journaled two times throughout the study. Students first journaled prior to the beginning of the unit and after the completion of the unit. The questions the students answered during both journal sessions can be found in Table 4.

Table 4 *Student Journal Questions*

Student Journal Phase	Guiding Questions
Before Unit Implementation	<ul style="list-style-type: none"> - How would you describe a typical day in math class to someone who had never experienced it? - When do you use mathematics outside of school?
After Unit Implementation	<ul style="list-style-type: none"> - Previously you answered the question, how would you describe a typical day in math class to some who had never experienced it? Would these last few weeks be described differently? - Previously you answered the question, when do you use mathematics outside of school? Are there any new ways you think mathematics can be used outside of school?

Data Analysis

Data from the nine students were analyzed after the students participated in the complete data collection. For the ABP rubric, a total of eight students responded to the initial rubric, seven students to the mid-unit rubric, and five students to the final rubric. For the mentor and supervisor ABP rubric, both the teacher and the mentor responded to the initial and final rubric. For the student survey, eight students responded to both the initial and final survey. For the

student journals, seven students responded to the first collection, but only four students responded to the final collection. The students who participated in the initial data collection for all three data types were not necessarily the same students who participated in the mid or final data collection. Each students' participation in each of these data collection methods can be found in Table 1.

To answer the first research question, what is the teacher's experience in developing and implementing lessons incorporating asset-based pedagogy (ABP) in a secondary mathematics algebra I unit, I used open coding and constant comparative method (Corbin & Strauss, 2008) to identify themes that emerge. I used codes for each of the four areas in asset-based pedagogy studies: critical awareness, cultural knowledge, cultural content integration, and expectancies. This data will provide information about which resources help a teacher develop and utilize ABP along with where development and implementation are easier and where it is more difficult.

To answer the second research question, what are algebra I students' perceptions of the implementation of asset-based pedagogy, I used the student surveys and the student ABP rubrics. The survey data was exported from Google Forms to an Excel document for analysis. The surveys were analyzed using pairwise comparison. Differences between each student's responses will be identified and evaluated to determine changes between a student's first survey response (prior to the unit) and second survey response (after the unit). The ABP rubric was exported into an Excel spreadsheet from Google Form. Open coding and constant comparative method were used to find themes that emerge within the following codes: critical awareness, cultural knowledge, cultural content integration. The mentor and supervisor ABP rubrics were analyzed in the same way and the data was used to help explain similarities and differences between the teacher's and students' responses and feelings about implementation of ABP.

To answer the last research question (to what extent do students' initial, mid, and ending perceptions of mathematics differ for students who experience a secondary school algebra unit planned and taught using asset-based pedagogy?), I used open coding and constant comparative method to identify themes in terms of students' mathematical perceptions. The data provided input into how students perceived math before and after the implementation of ABP.

Findings

The following section will discuss the findings of this study. The aims of this research study were to document the creation of a secondary mathematics unit using ABP, to explore a teacher and student's perceptions on the implementation of ABP, and to identify changes in students' relationship with mathematics. The research questions explored were:

- What is the teacher's experience in developing and implementing lessons incorporating asset-based pedagogy in a secondary mathematics algebra I unit?
- What are algebra I students' perceptions of the implementation of asset-based pedagogy?
- How do the mathematics perceptions held by students who experience a secondary school algebra I unit taught using asset-based pedagogies change after the unit delivery?

Development and Implementation of ABP

The teacher journals were utilized to answer the first research question; what is the teacher's experience in developing and implementing lessons incorporating ABP in secondary mathematics Algebra I unit? The aim of this section is to show the aspects of ABP that are easier and more challenging to plan and implement in a secondary math classroom.

In order to develop lessons using ABP, I first needed to establish an understanding of who my students were. I began of the school year by having students complete an icebreaker activity to help me to gather useful knowledge I needed. For this activity, I created a collaborative PowerPoint with each students' name and then the students were tasked with putting three to four pictures of something they could use to describe themselves by their names. Once every

student completed this, we shared the PowerPoint with the class and the students had the opportunity to explain what each picture meant and why they chose it.

This presentation was then used during the planning of my algebra 1 unit about equations implementing ABP. To incorporate student interests and what I knew about them, I created word problems that used what they had indicated they enjoyed or activities they typically participated in. These problems were designed for each type of equation within the unit which included one-step equations, two-step equations, multi-step equations, and combining like terms. On top of this, students then created word problems, called Connect to Me Problems, modeling mine and based on something they were interested in to help them apply what we were learning to their own lives. A select few of these questions were then used to assess the students at the end of the unit. An example of a question created by the teacher based on students' provided information can be found below:

Jeff [pseudonym] plays games on the Nintendo Switch. Each Nintendo Switch Game costs \$60. Over the course of the year Jeff has saved \$150, how many new games can Jeff buy?

An example of a Connect to Me problem created by a student is:

I bought my little sister her own set of acrylic paint and brushes. I wanted to get her the paint that comes in 20 oz. Each 20 oz of paint costs \$10. The set of brushes that I bought are \$5. I have spent \$75 on everything. How many colors did I get her?

$$\text{Equation: } 10p + 5 = 75$$

$$\text{Solution: } p = 7$$

Planning of ABP

The initial teacher journal entry asked seven questions. From the answers to these questions, I showed that I took steps to increase my critical awareness throughout my college career leading up to student teaching. I noted that, “I had taken the time to take classes and seminars about marginalized groups of students and how they are affected by the education system. For example, one class that I took was focused on teaching mathematics in urban and rural high needs areas. These classes exposed me to readings, guest speakers, and activities that allowed us to begin to educate ourselves on the inequities found in school and in math classes. Within this journal entry, I also note that once I was assigned the school, “I did research on the school and the surrounding area to determine the percentages of the student population in terms of race, gender, and socioeconomic status.” And finally, after being assigned a mentor teacher and meeting my students, I indicated that I also “talked with my mentor teacher about his experience with the students and the area along with talking to the students to determine what students like and their history.” These notes show how I tried to increase critical awareness as I grew as an educator throughout my schooling and student teaching experience.

The teacher journal indicated that student’s cultural knowledge was integrated into the mathematics unit using the information completed on the PowerPoint presentation described earlier in this section. Cultural knowledge was also integrated when students wrote their own equation questions that would be used for their final assessment. Examples of the types of questions asked and Connect to Me problems integrated were described above. This journal entry ends with discussing teacher expectations. The journal indicated that teacher expectancies were integrated into the lessons “throughout the homework assignments, quizzes, and tests.” I indicated that students were expected to turn in their homework assignments for participation

points and were asked to answer test and quiz questions to the best of their ability. These expectations were mostly in place already, established by the mentor teacher's rules put in place at the beginning of the year.

Implementation of ABP

Throughout the journal entries during the unit, further observations can be made. Each day I answered six questions after the teaching of the lesson using ABP. I often indicated that critical awareness was not shown in the lesson except on days when the students worked on word problems that were written based off their interests. I would note that "Critical awareness was not shown during this lesson..." and then further explain that the students were either taking notes or working on a quiz or test. However, there were two occasions where students also created word problems themselves based on their interests that they were told would be use for the future tests and quizzes. These days I indicated higher levels of critical awareness by noting:

Often times in word problems there are biases and experiences that cater towards white upper middle-class students giving students who are not in the group a disadvantage. Giving the students problems they could relate to could make them more relatable and actually test their knowledge of being able to do the math instead of understanding the problem.

On days when I indicated higher levels of critical awareness, I made claims such as:

Critical awareness was strong when designing the worksheet and the problems.

Critical awareness was weak when teaching this because I did not explain why I made these choices.

These entries indicate that often critical awareness was weak and when it was intended to be stronger, I felt like I was not explaining my choices to my students enough, so they did not understand the integration. As a pre-service teacher teaching in an unfamiliar area, I found it was very difficult to completely grasp the students cultural background especially as this unit was taught with only a month of living in the area.

Similar to showing critical awareness, cultural knowledge was shown on the days when the teacher planned problems based around the students or the students designed their own problems, but not on the other days. However, often I indicated that student interests were utilized more than cultural content. For example, in one entry I said:

Cultural knowledge integration was not planned; however, student interests were.

They were integrated into each of the problems, but I believe it was not integrated completely as planned once we started solving the problems.

This theme emerges throughout each journal entry as I indicate that it was difficult to integrate culture since critical awareness was difficult to obtain early on. When it is noted that cultural knowledge was not integrated as planned, I note that:

The students did not know the problems may be based off of students in different classes so explaining that to them may have felt like this was better integrated. It felt like we were just completing normal math word problems.

Since I structured worksheets to include one problem for a student in each class, for any one student, only one problem felt meaningful in each of the classes. For this reason, students may not have experienced cultural content and interest integration as I had planned.

The final question on the teacher journal was about teacher expectancies. I typically indicated that expectancies were clearly addressed and addressed as planned. These expectancies often had to do with what the students needed to complete each day while in class and what they needed to do for homework to be successful. The expectancies were often expressed verbally and through modeling throughout the lessons. Some examples of student expectancies were participating when asked questions, completing a warm-up when they arrived to class, take notes during class, work independently or with peers when given the time to work on in class assignments or homework, and turn in the homework by the start of class each day. Some of these expectations were surface level; therefore, more depth was provided into what was expected when needed such as, more details about homework or classwork expectations. These expectations arose as needed because each assignment was different leading to differing expectations. The journal also indicated that by watching the teacher complete the problems throughout the lesson the students were shown what they were expected to do when they began to work on the problems for classwork or for homework.

Overall, the planning and integration of ABP was challenging, but something that I believe can be strengthened over time. As a pre-service teacher who only knew her students for a few weeks prior to teaching, it was very difficult to understand the culture and interests of my students. With more time and more teaching experiences, I can work to build my critical awareness which can strengthen my ability to integrate students' culture into the classroom. While implementing ABP I also learned that it was difficult for my students to see that the lesson connected to them when only a select few problems related to their specific class. Being up front and direct with students about my intentions could have made implementation easier and more beneficial.

Students' Perceptions of Implementation of ABP

The second research question asked was, what are algebra I students' perceptions of the implementation of asset-based pedagogy? The student surveys and the student ABP rubrics were analyzed to provide insight into this question. Students, the mentor teacher, and the supervisor provided a rating on a scale ranging from 0 to 3 for each category in the ABP rubric. These choices can be seen in Table 5. For the surveys, the students had five rating options ranging from strongly disagree to strongly agree except in one question for which they chose very high, high, moderate, low, or very low. There were seven students who answered both the initial and final survey. Their answer responses for each question can be found in Table 6.

Table 5 *ABP Rubric Choices*

Rating	Description
0	My teacher never...
1	My teacher sometimes...
2	My teacher often...
3	My teacher always ...

Table 6 Student ABP Responses

	My teacher understands my history and culture.	My teacher understands the biases within the school and the curriculum.	My teacher views my culture as valuable in the classroom.	My teacher views my interests as valuable in the classroom.	My teacher integrates my culture into course content.	My teacher integrates content into the course that is meaningful to me.	My teacher has _____ expectations of me.	My teacher's expectations align with my personal expectations.	My teacher's expectations are fair.
6 Initial	Neutral	Strongly Agree	Neutral	Neutral	Neutral	Neutral	Very High	Strongly Agree	Strongly Agree
6 Final	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Very High	Strongly Agree	Strongly Agree
14 Initial	Agree	Strongly Agree	Strongly Agree	Strongly Agree	Neutral	Strongly Agree	High	Strongly Agree	Agree
14 Final	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Very High	Agree	Agree
23 Initial	Strongly Agree	Strongly Agree	Strongly Agree	Agree	Neutral	Agree	Moderate	Strongly Agree	Strongly Agree
23 Final	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Moderate	Strongly Agree	Strongly Agree
1 Initial	Agree	Strongly Agree	Agree	Neutral	Disagree	Agree	High	Agree	Agree
1 Final	Strongly Agree	Strongly Agree	Agree	Agree	Strongly Agree	Agree	High	Agree	Agree
5 Initial	Neutral	Agree	Disagree	Disagree	Disagree	Disagree	Moderate	Neutral	Strongly Agree
5 Final	Neutral	Neutral	Neutral	Agree	Agree	Agree	High	Strongly Agree	Strongly Agree
4 Initial	Agree	Strongly Agree	Agree	Agree	Neutral	Agree	High	Agree	Strongly Agree
4 Final	Agree	Strongly Agree	Agree	Strongly Agree	Neutral	Agree	High	Neutral	Agree
24 Initial	Neutral	Agree	Neutral	Agree	Neutral	Agree	High	Strongly Agree	Strongly Agree
24 Final	Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Agree	High	Strongly Agree	Strongly Agree

Critical Awareness

When looking at the evidence for the history and culture category, two students rated this category a 0, three students rated a 2, and three students rated a 3. Thus, most of the students thought I showed no or only some understanding of their history and cultures. The students initially indicated that “she doesn’t really talk about it” or “I’m not quite sure what that has to do with math, but okay.” These responses along with the student ratings indicated that students did not perceive that I had a strong understanding of their history and cultures. When the students filled out this rubric, they had only known me for about four weeks and I had only taught them a handful of times; therefore, their scores may be more reflective of how well they knew me. However, it can be noted from my supervisor and mentor that I understood history and culture by detailing “accommodations for students in need of them” within my lesson plans, by “having available documents in their [student’s] native language,” and by creating the PowerPoint at the beginning of the year to get to know my students better. To accommodate for students who spoke a language different from English, I utilized translation software so my students could see what I was saying in their own language and I utilized this technology to translate all classroom documents into their home language. Both accommodations provided better access to the learning materials used in class. The comments made by the supervisor and mentor teacher show that my understanding was stronger than what students had believed; however, this indicates that I did not do a good job showing my students that I understood them in this regard.

The responses for the second ABP rubrics, show that one student provided a score of 0, one student a 2, and the remaining five students a 3. For the third rubric, 1 student rated a 2 and

the remaining four a 3. Therefore, in both rubrics it can be noted that most students indicated that I showed a stronger understanding of their cultures compared to the initial survey. The students did not provide much evidence for this growth other than one student who wrote, “the lessons are based off of my culture.” The mentor teacher and supervisor again noted that activities were planned around information from students and that I planned for accommodations for students that needed them. We can also observe this growth from the survey responses. Four of the seven students indicated higher responses in their second survey compared to the first while the other 3 indicated the same response. The combination of the ABP data and the survey show that throughout the two weeks (approximately eight hours of instructional time) I taught using ABP strategies, the students believed that I had a better understanding of their history and cultures compared to when I started. The methods of data collection cannot prove a correlation between students’ perceptions and implementation of ABP; therefore, it is hard to know if this was due to the implementation of ABP, if the students had the opportunity to get to know me better, or some combination of both.

The next question on the ABP rubric and the survey asked the students about my understanding of the biases within the school and curriculum. For the initial ABP survey two students rated the category a 2 while the remaining six students rated a 3 showing that most of these students felt that I had a strong understanding of biases. One student indicated that “my teacher knows about the biases in the system as my teacher can relate to these.” This piece of evidence shows that this student felt like I could connect to the biases; therefore, I understood them. Another student indicated that “she is a nice teacher and calls on every student to help her out with a problem.” This piece of evidence indicates that this student associated calling on all students as not being biased; therefore, I understood the biases. My mentor and supervisor add to

this by indicating I have “picked up on trends and weakness;” however, “this is a difficult task coming into a school year, especially given the current hybrid model.” The hybrid model of teaching consisted of a portion of students in person with the remainder of the students learning from home. These comments show that I was developing an understanding and over time I would develop a better understanding.

When looking at the student responses for the second ABP rubric it can be noted that three students scored this category a 2 and four students a 3. For the third rubric, all five students rated a 3. It is hard to describe the discrepancy in scores for the second rubric as there was little to no evidence provided by the students about why they chose their scores. However, throughout all 3 iterations of the rubric completion it is evident that students believed I had a strong understanding of the biases. For the third rubric one student again commented, “My teacher helps everyone.” Similar to the comment in the first rubric provided by a different student, they believe that by helping everyone I understand the biases in the school system. When looking at the survey question about biases, five of the seven students indicated that they strongly agreed with the statement and they indicated this again in the final survey. One student shifted their response from agree to strongly agree while one student shifted their response from agree to neutral. Overall, the survey shows the same trends as the rubric in that the students initially believed I had a strong understanding of the biases and that was maintained throughout the unit. For these reasons, it is hard to conclude how the implementation of ABP might have influenced how they thought about my understanding of biases.

Cultural Knowledge

The next section of the rubric discusses teacher's understanding of cultural knowledge. In this category, for the initial survey, I received two 0s, four 2s, and two 3s indicating that most students believed I never or often validated the students' cultures. Yet in students' evidence many of them indicated that they did not understand what this question meant. Scores by my mentor and supervisor for this category were higher and they noted in their evidence that I "show much sensitivity towards students and acknowledge them in positive ways" and that I asked the students to write questions based on their experiences. These two pieces of evidence indicate that they were able to observe that I acknowledged students' culture in some ways. However, when looking at students' responses about student interests it can be noted that this section was scored a 0 by one student, a 2 by three students, and a 3 by four students. In their evidence they note that "they do take our interests into consideration" and "my teacher is interested in what I have to say always." My mentor and supervisor also note that I "begin classes asking students about their day and to share something that happened during their day or previous day" and that I often have conversations with students before or after class and integrates that information into lessons. Comparing these two categories shows that prior to ABP it could be seen that I cared about student interests, but students' culture was less evident.

For the second ABP rubric one student rated the category a 1, two students rated it a 2, and four students rated it a 3 for cultural knowledge. And for the third rubric two students scored the category a 2 while three students rated a 3. These scores are consistent with growth in what the students believe I validate in terms of their cultures; however, if the students did not understand the question the first time the data for these two rubrics may not be accurate either. For the survey, three students increased their ranking while four students kept their responses for

the question asking them if their teacher views their culture as valuable in the classroom. These responses show that throughout the implementation of ABP the students felt like I valued their cultures more. It is hard to tell for these questions whether the increase was due to ABP implementation or simply that they got to know me better as a teacher. When students originally took the survey, the students' may have had their own visions of a student teacher and a white woman; therefore, their shift in scores may also represent them working through their own perceptions.

For the second ABP rubric question about valuing student interests, one student scored the category a 0, one student scored me a 2, and five students scored me a 3. For the third rubric one student gave a 2 while the remaining four students gave me a 3. The students noted that "she always asks us if we had a good day" and "my teacher does include our interests a lot during class." These scores and evidence show that the students felt that over the two weeks, they saw their interests being valued more within the class and by me. When looking at the survey question about valuing student interests six of the seven students increased their scores for the question asking them if their teacher values their interests in the classroom while one student kept the same response which was strongly agree in the first survey. As noted in the teacher journals, student interests were integrated more frequently and easily compared to students' culture; therefore, it would be plausible to say that ABP could have affected the way they saw their interest valued in the classroom.

Cultural Knowledge Integration

The final two questions on the ABP rubric asked the students the extent to which I integrated their culture and their interests. For the question focused on integrating student culture, four students rated a 1 while four students rated a 3. These wide range of scores show that there were mixed feelings about the extent of integration; however, it can be seen in the evidence that the students' conceptions and beliefs in terms of mathematics may have affected their response to these questions. The students made comments such as, "what does this even mean" and "once again, we are learning math." However, when looking at the question about student interests the category received a score of 2 from four students and a score of 3 from the remaining four students. Interestingly the 2s were provided by students who had rated culture with a 1, so they believed that their interests were integrated better than their culture. One student also commented, "my teacher uses my interests as lesson." These pieces of evidence and scores show that initially students had varied feelings about cultural and interest integration, but felt interests were integrated more than culture.

When looking at the scores for the second and third ABP for cultural integration, it can be noted in the second rubric that one student gave a 0, one student gave a 1, one student a 2, and the remaining three students a 3. For the third rubric two students gave a 2 while three students gave a 3. For all these scores the students' responses are varied and there is little evidence to support why students chose the responses that they did. When looking at survey question for cultural content integration six of the students increased their responses while 1 student kept their response the same at neutral. Both the ABP rubric and the survey show varying results which could be since students did not understand what was being asked about integrating their culture.

Therefore, it is hard to make any conclusion about the effectiveness of ABP on students' perceptions of cultural content integration.

When looking at the second and third rubrics for interest integration, one student rated it a 1, two students a 2 and four students a 3 for the second rubric. For the third rubric two students gave a 1 while three students gave a 3. Two student comments in these rubrics indicated that the students felt that I was good at integrating interest; however, due to the variability in the responses it is hard to make any conclusions about student interest integration. When looking at the survey, three students indicated higher responses from the first to the second survey while three students held their responses at agree and one at strongly agree. These scores show that most students agreed or strongly agreed from beginning to end, thus it is hard to say if implementation of ABP changed how students felt their interests were integrated into the course content. This conclusion is interesting as the students felt their interests were valued more in the classroom, yet they did not see it integrated into what they were learning.

Teacher Expectancies

Finally, the survey ends with three questions about teacher expectations. Four students believed that the teacher expectations stayed the same throughout the unit and they felt that these aligned to their personal expectations and that these were fair expectations. One student believed that the teacher expectations stayed the same throughout the unit; however, this expectation aligned less with their own and was less fair after the two weeks. One student indicated that teacher expectations were fair the entire time, but that they increased in the two weeks and this was more aligned with their own after the two weeks. The final student indicated that the

teacher's expectations were fair throughout the two weeks, but that they increased which aligned better with their personal expectations. Overall, the majority of students believed that their perception of teacher expectations aligned with own expectations and for the most part were fair. However, with little changes between the two weeks and without evidence from the students, it is difficult to conclude how the implementation of ABP impacted teacher expectations. High expectations may be engrained into the school as a norm; therefore, students may have also felt that there were high expectations for them prior to my teaching which could also explain the lack of shifts in students' perceptions.

Overall, after implementing ABP the students indicated that they felt their interests were valued more in the classroom, but no other major conclusion could be made about students' perceptions of teacher's critical awareness, teacher's cultural knowledge, cultural content integration, and teacher expectations. As indicated in the teacher journals, the students may not have been aware of the changes that the teacher was making as it was difficult and not explicitly explained; therefore, they may not have been able to see changes that were happening. Thus, the increases in the data that were seen could have been due to the students better understanding me as a teacher or ABP, but a direct correlation cannot be made.

Students' Perceptions of Mathematics Post ABP Implementation

The final research question, how do the mathematics perceptions held by students who experience a secondary school algebra I unit taught using asset-based pedagogies change after the unit delivery, was answered through the responses of student journal entries. Students were asked the question: How would you describe a math class to someone who had never

experienced it? Then they were asked, after the two weeks, would they describe it any differently. Students' responses to both questions can be found in Table 7.

Table 7 Student Journal Responses: How would you describe a math class to someone who had never experienced it?

Initial Journal Entry	Final Journal Entry
Normal math class.	N/A
Hard	It would be hard and yes.
It is easy if you pay attention.	We practice longer.
Same thing just someone new to meet.	N/A
It is usually calm and easy. We take a lot of time on 1 subject but that's a good thing because she wants to make sure people get the lesson.	N/A
A typical day is going through the lesson, asking questions, and then receiving homework.	N/A
I would say the teacher always tries her best to explain how to do the equations. Its really fun when you pay attention and easy to understand. You do a warm-up, check homework, take notes, then have time to do your homework.	N/A

Some students initially described their vision of a math class as what they have experienced in other math classes, some expressed the difficulty of the course, while others described the typical daily schedule followed by the teacher in their math course. Over the two

weeks the structure of the course did not change tremendously. Due to the major transition to remote learning, I felt it was important to keep a consistent structure to the class that the mentor teacher had already set. The lack of significant change could have affected the responses for the students' second journal entry.

Only two of the four students answered the second journal question, how would these last two weeks be described differently. Their answers did not deviate far from their initial responses leaving it difficult to come to conclusions about the effect to which their perception of the math classroom changed throughout the unit utilizing ABP.

The second journal question asked students, when do you use mathematics outside of school? For this question, two of the seven students indicated that they never use math outside of school while five students were able to provide examples of where they use math outside of the classroom. These responses can be found in Table 8. The follow-up question in the final journal entry asked, are there any new ways you think mathematics can be used outside of school? Three of the four students indicated that there were new ways of using math outside of school while one indicated that they could not think of any new ways. One of the three students indicated that they could use math to compare numbers which had been a focus prior to the unit and continuing through the unit taught with ABP showing the recognition of the usefulness of this topic outside of the classroom. As noted in the teacher journal, I was not explicit in explaining to students that the problems I created or the problems they created were ways that mathematics is used outside of the classroom which could have affected their final journal entries.

Table 8 *Student Journal Responses: When do you use mathematics outside of school?*

Initial Journal Entry	Final Journal Entry
I don't. What they teach us we never use!!!!!!!!!!	N/A
Money In cooking and baking.	No When comparing numbers.
At the store and counting money. We use it if we need to figure out a problem with numbers.	N/A
Never. In video games, homework, and shopping.	At the grocery store. Yes.
When I purchase items.	N/A

Overall, a change in students' perceptions of math is difficult to note due to the lack of responses in the final journal entry. Initially students had varied feelings about their perceptions of math. Some students believed that the math was hard while other students believed it was easy and this was consistent with how the small group of respondents felt after the implementation of ABP. Similarly, students saw math as useful when shopping, cooking, or baking and this was similar to the small responses in the final journal except for one change which correlated with the content of the material not the implementation of ABP. Thus, students' perceptions of math do not differ much before and after the implementation of ABP.

Discussion

The following section will aim to discuss the findings in terms of the literature, explaining the results of the findings, and providing implications for further studies. The data from the teacher journals, ABP rubrics, student surveys, and student journals will be utilized within this section. Our aim is to further explore a teacher's experience in developing and implementing lessons incorporating ABP, algebra I students' perceptions of the implementation of ABP, and the extent to which students' initial, and ending perceptions of mathematics differ for students who experience a secondary school algebra I unit planned and taught using ABP.

Development and Implementation of ABP

Within the findings it was found, using the teacher journal, that it was challenging to plan and implement ABP especially as a novice teacher. Implementing ABP within this study was difficult for several different reasons. To begin, I grew up and went to school in a very different area from the one that I was teaching in. Therefore, it was very difficult to begin to understand the students' culture, the community culture, and the school culture within just a few days of living where I was teaching. With more time, I could have had the ability to gain a better understanding of my students, the community, and the school which could have resulted in a more meaningful engagement of ABP.

During my student teaching experience, my students were learning during the COVID-19 pandemic. The pandemic caused a shift in the school environment that was new for both the teachers and the students. This shift caused two difficulties in my data collection. First, I was unable to hand out physical copies of consent forms making it extremely difficult to receive

responses from both parents and students which result in a low participant number for this study. Second, about two-thirds of my students were learning remotely, which resulted in a more difficult time managing what the students were doing; therefore, it was hard to regulate who submitted responses to data collection forms and who did not. Lack of participation resulted in having variable completion rates for each type of data collection.

The pandemic also resulted in a change in learning and teaching methods. This was the first year that my students were utilizing one-to-one technology with laptops and this was the first time that students were learning from home. Remote learning also afforded less opportunities for casual connections via conversations in the hallway, before class, and through announcements. There were also fewer chances to attend school and community events to help learn more about my students and their families. These changes made it very difficult to implement ABP in the classroom. My goal was to try and keep as many consistencies as I could for my students, so the students felt comfortable in the learning environment. Consistency was also beneficial for students who had to miss school for various reasons. By trying to maintain the class structure, the implementation of ABP in this study was hindered.

However, there were times when ABP was implemented in this study. The icebreaker activity and Connect to Me math problems were used to gather information on students' interests to assist in the implementation of ABP in this study. The icebreaker activity was completed at the beginning of the year by the students. They were asked to describe themselves using three to four images which they then shared with the class. The Connect to Me math problems were completed throughout the unit implementing ABP and asked students to create equation word problems that were focused in an area of their interest.

The students also worked on problems throughout the unit implementing ABP that utilized the information they provided at the beginning of the year. The aim of this activity was to utilize math to build an even deeper understanding of the cultural knowledge their students hold which López (2017) explains is a necessary ingredient for ABP. Due to not being able to see all of my students all of the time, it was very difficult to begin to know them and their cultures. Therefore, the information they provided at the beginning of the year was most relevant to connect the mathematics to their interests. Provided more face-to-face time, I would have liked to incorporate more knowledge that I learned from the students into the mathematics to better engage them in ABP.

The literature review explains several examples of how to utilize ABP in a mathematics classroom (Leonard, Brooks, Barnes-Johnson, & Berry, 2010; Harper, 2019; Nasir & McKinney de Royston, 2016; Chao & Marlowe, 2019). These examples show how to utilize issues in the school communities, social justice, and cultural interests into mathematics which showed me early on in the process of this study how to best incorporate ABP in the classroom. Due to the school environment and my position as a student teacher, it was very difficult to try and bring some of these topics into the classroom. With more experience and more comfort in my environment, these examples provide a good foundation on how I would better incorporate ABP into my mathematics classroom.

Students' Perceptions of Implementation of ABP

The findings on students' perceptions were limited due to the method of data collection and student absenteeism. The conditions of the administration of the ABP rubric were one

limitation to this study. While students were filling out the ABP rubric, they had the opportunity to add comments to each section to explain why they choose the score they did. However, it was found that often students did not add any additional comments to their ratings which made it difficult to make any conclusions about their perceptions of the implementation of ABP. To elicit better responses from students, I would recommend conducting focus groups instead of utilizing a collection of surveys. With focus groups, more targeted questions and follow-up questions could have been asked that elicited the same information as the ABP rubric and survey, but with more opportunity to elicit better student explanations of why they were thinking the way they were. Information like this would have been more beneficial when it came to making conclusions about the data.

Another limitation of this study was the wording of the questions posed to the students. Whether asking survey questions as done in this study or conducting a focus group as recommended for future studies, the questions asked to students should be phrased so they are more understandable. It appeared that students did not understand the phrases biases, cultural, and cultural integration. Questions about these topics should still be asked, but it would be beneficial to start by asking the students how they define these terms to add context to their answers or ask questions without the need for vocabulary. Another additional question that would be useful to know is how students would describe their culture to someone. This question would allow them to define their culture while providing them time to think about how the terms they are being asked about relate to them. By understanding how students define and understand the terms used in the questions, the information that they provided would have been more valuable because it would have provided the students the ability to answer the question as opposed to commenting that they are unaware of the meaning.

If the survey were to be updated, two main changes would need to be implemented. First, key terms would need to be defined for the students. For example, when asking students about culture, biases, and content integration, we would need to provide an example or explanation of what we mean when we use those terms. These explanations would provide a better foundation for all students to answer the questions and answer them with a deep understanding. The survey would also need to provide the students with an opportunity to describe why they chose the answers that they did. By having them explain, the answers to their questions could provide more meaningful information about their perceptions of the implementation of ABP.

Another limitation to the study was the length of time spent planning and implementing ABP. The students only had experience with me and my teaching strategies for a few weeks only two of which consisted of ABP implementation. Change happens over time and if provided the opportunity to use ABP strategies for longer, different results may have begun to show. Some of the changes that were implemented were also small and may not have been noticed by the students especially since I was a new teacher to them. They may have associated the changes that I made with having a new teacher.

In addition, I am unaware of other teachers in the school that were using ABP strategies; therefore, students were only exposed to this type of pedagogy for 50 minutes a day. Thus, the shift to ABP only shifted what was being done within our classroom and the students were not able to see a shift in the school culture. However, if ABP becomes a pedagogy that all teachers use and it becomes systemic within the curriculum and professional development, then maybe we will begin to see a shift in student thinking about how teachers view and integrate their culture.

Students' Perceptions of Mathematics Post ABP Implementation

As indicated in the findings, when students were asked about the use of math outside of the classroom, they mostly provided examples that dealt with money and shopping. These results align with a study done by Baki, Çatlıoğlu, Coştu & Birgin (2009) in which high school math students were asked to give examples of how math connects to real-life. They found that often students connected math to general calculations and shopping. Thus, the findings from the initial student journal in this study aligned with students in a similar group as them.

To try and shift student thinking about their perceptions of the use of mathematics during the implementation ABP, they were provided examples on how equations can be used to solve several different problems, such as wedding planning, baking, and sports. However, students were not noticing that these applications are examples of how we use math every day. One thing that might have led to the lack of connection was making the examples too similar to what they may see in their textbook and not showing the students how we would really use this when we leave the classroom. For example, when baking, we are constantly solving equations; however, many calculations are done mentally. Or when watching sports, you may try and figure out how many more points a team needs to win which utilizes the structure of an equation to solve without writing an equation and using common symbolic manipulations. As noted in the findings, I was not explicit enough when explaining these applications to students, so they did not notice all the areas of their life they use the math we were learning about.

A good foundation for connecting math to students' life can be found in the literature (Leonard, Brooks, Barnes-Johnson, & Berry, 2010; Harper, 2019; Nasir & McKinney de Royston, 2016; Chao & Marlowe, 2019). By incorporating topics such as social justice and specific aspects of students' culture, students' may be able to better connect math to their

personal lives instead of provide surface level connections. I could have better incorporated topics students cared about by collecting better and more meaningful data on my students. I could have asked them questions such as:

- What in the news are you interested in learning more about?
- What questions do you have about what is happening in your community?
- What are traditions that you and your family follow throughout the year?

Questions like these could have provided a deeper insight into my students and provided me the opportunity to connect the mathematics with their lives in a more meaningful way. Due to being a novice teacher, in a new community, and new learning environment I was unable to ask these types of questions to my students and they may not have felt comfortable talking to me about them since many of them only saw me two times a week. More time with my students and more time in the community could have provided a better foundation to begin to shift students' perceptions of the use of mathematics.

Conclusion

Asset-based pedagogies have been shown to support historically marginalized students while helping students develop identities to promote higher achievement outcomes (López, 2017). To effectively implement ABP into the classroom as López (2017) explains, a teacher must possess a strong critical awareness, a deep cultural knowledge, and the ability to integrate student experiences into the instruction. The purpose of this study was to document and gather one case of implementation of ABP in a secondary mathematics classroom.

Historically marginalized students are often perceived to be lower in the hierarchy in terms of mathematical ability compared to their white peers (Martin, 2009). Thus, it is of great importance to integrate ABP in the mathematics classroom to help promote positive mathematical and achievement identities. For ABP integration to be successful, teachers need to be educated on how to plan for and implement ABP in their classroom. With the appropriate tools and resources ABP could begin to shift historically marginalized students' projections in mathematics.

Due to limited data in this study and the difficult conditions of the pandemic, the findings were not significant in terms of students' perceptions on the implementation of ABP and students' perceptions of mathematics. However, this study began to develop insight into the planning for ABP and changes that can be made to better understand students' perceptions of ABP and mathematics. Most importantly, it was found that being a novice teacher makes it extremely difficult to integrate ABP into the classroom due to limited critical awareness and understanding of students' cultural knowledge. This difficulty arises because of the limited time available for teaching, understanding student culture, and the lack of opportunities to change the

curriculum. As López (2017) notes, there is a need to provide pre-service teachers with course work that helps build these skills that are often lacking in novice teachers. The findings in this study also indicate that it is with outmost importance that we begin to teach pre-service teachers the skills needed to build a stronger critical awareness earlier in their careers.

Further iterations of this study can be done to better document secondary mathematics students' perceptions of ABP implementation and of mathematics. A study of this type should be conducted over a longer period and should utilize methods, such as focus groups or interviews, to elicit student thinking to gather more significant information on their opinions of the topics discussed in this study. The findings within this study support further understanding of students' perceptions to determine the effectiveness of a teacher's implementation of ABP to help provide insight into how a teacher can better plan and implement ABP into a secondary mathematics classroom.

Appendix A

Student ABP Rubric

Component	3 points	2 points	1 point	0 points	Comments
History and Culture	My teacher shows a strong understanding of my history and culture.	My teacher shows some understanding of my history and culture.	My teacher shows little understanding of my history and culture.	My teacher shows no understanding of my history and culture.	
Biases	My teacher shows a strong understanding of biases in the school and curriculum.	My teacher shows some understanding of biases in the school and curriculum.	My teacher shows little understanding of biases in the school and curriculum.	My teacher shows no understanding of biases in the school and curriculum.	
Cultural Knowledge	My teacher always validates my cultural knowledge.	My teacher often validates my cultural knowledge.	My teacher sometimes validates my cultural knowledge.	My teacher never validates my cultural knowledge.	
Student Interests	My teacher always values my interests.	My teacher often values my interests.	My teacher sometimes values my interests.	My teacher never values my interests.	
Cultural Content Integration	My teacher always integrates my culture and/or interests into the lesson.	My teacher often integrates my culture.	My teacher sometimes integrates my culture.	My teacher never integrates my culture.	
Student Interests Integration	My teacher always integrates my interests into the lesson.	My teacher often integrates my interests into the lesson.	My teacher sometimes integrates my interests into the lesson.	My teacher never integrates my interests into the lesson.	

Appendix B

Mentor and Supervisor ABP Rubric

Component	3 points	2 points	1 point	0 points	Evidence
History and Culture	Teacher shows a strong understanding of students' history and culture.	Teacher shows some understanding of students' history and culture.	Teacher shows little understanding of students' history and culture.	Teacher shows no understanding of students' history and culture.	
Biases	Teacher shows a strong understanding of biases in the school and curriculum.	Teacher shows some understanding of biases in the school and curriculum.	Teacher shows little understanding of biases in the school and curriculum.	Teacher shows no understanding of biases in the school and curriculum.	
Cultural Knowledge	Teacher always validates students' cultural knowledge.	Teacher often validates students' cultural knowledge.	Teacher sometimes validates students' cultural knowledge.	Teacher never validates students' cultural knowledge.	
Student Interests	Teacher always values students' interests.	Teacher often values students' interests.	Teacher sometimes values students' interests.	Teacher never values students' interests.	
Cultural Content Integration	Teacher always integrates students' culture and/or interests into the lesson.	Teacher often integrates students' culture.	Teacher sometimes integrates students' culture.	Teacher never integrates students' culture.	
Student Interests Integration	Teacher always integrates students' interests into the lesson.	Teacher often integrates students' interests into the lesson.	Teacher sometimes integrates students' interests into the lesson.	Teacher never integrates students' interests into the lesson.	

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ACADEMIC VITA OF CARLY SIEGLE

Education

The Pennsylvania State University, University Park, PA

Schreyer Honors College

Bachelor of Science in Secondary Education/ Mathematics Option and Bachelor of Science Math/ Systems Analysis Option, May 2021

Work Experience

Student Teaching, Ambridge Area High School

Student Teacher, August 2020 – December 2020

- Taught 9th grade Algebra 1 in a hybrid learning environment for 11 weeks and a synchronous virtual environment for three weeks.

Teaching and Learning with Technology, The Pennsylvania State University

Undergraduate Researcher, October 2018 – present

- **Active Learning Scoping Literature Review:** Read abstracts and the literature to find pieces of scholarly work which will be useful in pursuing our research goals: provide clarity on the term active learning as defined in the literature, identify gaps in the literature, summarize research efforts, and make recommendations to help advance activity around active learning.
- **Blue Box Active Learning Space Case Study:** Analyze audio and video data to find pieces of evidence that support each of the four sections of the Productive Disciplinary Engagement framework to help us study the extent to which the active learning space and the resources in the room support students' productive disciplinary engagement. (Publication Pending)
- **FLEXspace:** Worked with FLEXspace, an open resource aimed at improving learning spaces, to build the repertoire of resources on the website by contacting researchers and universities for information about their classroom spaces and research.

Krause Innovation Studio, The Pennsylvania State University

Consultant, August 2018 – May 2020

- Assist professors and students with scheduling and technology in the Krause Innovation Studios.

College Extracurricular Activities and Leadership

College of Education Student Council

September 2017 - present

- Selected after an interview and application process to represent the College of Education to promote communication between staff and students within the College of Education. Held position of president for the 2019-2020 school year and treasurer, apparel chair, and co-recruitment chair for the 2018-2019 school year.

SHO TIME Group Leader

January 2019 – August 2019

- Chosen to be one of nine group leaders to plan the orientation for incoming freshman into the Schreyer Honors college while working with mentors to prepare them for the incoming students for the 2019-2020 school year.

Education Psychology Learning Assistant

January 2018 – May 2019

- Served as an undergraduate learning assistant for EdPsych 14. Held office hours to help students in the class and conducted review sessions to prepare students for exams.

SHO TIME Mentor

January 2018 – August 2018

- Participated in SHO TIME as a mentor for incoming freshman into the Schreyer Honors college to help with the adjustment to college life for the 2018-2019 school year.

Volunteer Service

State College Area School District

Tutor, September 2018 – May 2018

- Tutor two ninth grade students in Algebra One for one hour each for a total of two hours of tutoring a week.

Awards and Honors

November 2020

- Featured in the [Penn State News](#) for technology use in the classroom.

May 2019

- Featured in the Spring 2019 edition of the [Penn State College of Education Alumni Magazine](#)

ShapingEDU Conference

March 2019

- Invited and awarded travel funds to be a student representative for TLT/Penn State at ShapingEDU, a conference at Arizona State University focused on technology in education.