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Evaluating the Policies that Lead to STEM Educational Attainment at the University of Arkansas for Transfer Students

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Evaluating the Policies that Lead to STEM Educational Attainment at the University of Arkansas for Transfer Students

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Abstract

The US has a critical need to produce more STEM graduates and that need is exponentially more critical in Arkansas. Arkansas currently ranks last in the percent of STEM degrees conferred compared to overall degrees awarded. Students intending to pursue a STEM four-year college degree who start at a two-year college are significantly less likely to succeed in earning that degree. Arkansas passed Acts 672 and 182 aimed at strengthening the success of students who transfer from two-year colleges into four-year institutions. This study sought to evaluate the effectiveness of the Acts by determining if the University of Arkansas (UA) has seen an increase in the number of entering STEM transfer students along with an increase in the graduation rates compared to before 2005 when the legislation was passed. Based on the community capitals framework, select cultural and human capital variables for each Arkansas county were analyzed to determine their effect on STEM transfer rates.

This study found the graduation rate of STEM transfer students decreased after each Act was enacted. Subsequent analysis found a higher percentage of STEM transfer students failed to graduate from the UA, compared to entering new freshman. Human capital variables were not a significant predictor of STEM transfer rates for Arkansas counties. Select cultural capital variables were indicative of increased STEM transfer rates. Two-year colleges that provided access to transfer centers increased the number of transfer students pursuing STEM degrees. Recommendations for various stakeholders within the two-year colleges, UA and the state of Arkansas are provided to increase STEM participation and transfer success.

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Dedication

This dissertation is dedicated to my mother and father, Nancy and Gary Hill: through your tireless work, you taught me the value of hard work. While David, Nathan and I might not have had endless resources growing up, we always had each other; in hindsight, I couldn't ask for anything more. You both pushed us to pursue our dreams and not to fear failure, because no matter what, we had a home and we had each other. Mom, as you retire this year after 41 years of being a special education teacher, you have been my inspiration—my one and only hope is that I will be able to impact as many students as you have. Thank you both.

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Chapter 1

Context of the Problem

Since 1990, the importance of increasing the number of science, technology, engineering and mathematics (STEM) graduates has been well-documented (Williams, 2011; Baber, 2011; Landon, McKittrick, Beede, Khan, & Doms, 2011). In 2012, the President's Council of Advisors on Science and Technology estimated one million more STEM graduates, beyond what is currently produced, will be needed in the United States (US) by 2022. With the US currently producing approximately 300,000 STEM graduates per year, an additional 100,000 graduates, or a 33% increase, would be needed to meet the demand (Olson & Riordan, 2012).

Arkansas has a critical need to increase the number of STEM graduates entering the workforce (ADHE, 2011). The 2016 documentary, *Starving the Beast*, took an in-depth look at the strategies and policies employed to cut state funding for higher education. Arkansas' institutions of higher education often refer to the Higher Education Funding Formula, created in 2003, calling for $200 million in new funding, as their reason for not employing more retention or graduation initiatives (Hill, 2012). Arkansas currently ranks 10th in the appropriations of state tax funds for higher education when compared to the state's gross domestic product (National Science Foundation, 2016). Given the generous state appropriations, combined with a low average undergraduate tuition rate, a STEM degree should be within reach for many Arkansans. Unfortunately, Arkansans are not pursuing STEM degrees at increasing numbers as the state currently ranks last in the percent of STEM degrees conferred compared to overall degrees awarded (National Science Foundation, 2016).

According to the National Science Foundation, engineers currently make up only 0.53% of the Arkansas workforce (compared with 1.12% of the total US workforce), forcing many

Arkansas employers to fill STEM positions with out-of-state or foreign labor (National Science Foundation, 2014). Overall, the percent of STEM degrees vs. non-STEM degrees has decreased in Arkansas between 2003 and 2013 by 5.9% despite multiple initiatives and policies that have been put in place to reverse this decline (National Science Foundation, 2016).

Nationally, students intending to pursue a STEM four-year college degree who start their academic career at a two-year college (TYC) are significantly less likely to succeed in earning that degree than students who start at a four-year institution (Wang, 2015). This is especially concerning due to the higher percentage of underrepresented, financially-needy, and first-generation students who begin at TYCs (Cohen & Brawer, 2003). Low transfer, retention and graduation rates are costing the state of Arkansas millions of dollars in lost state tax revenue annually (Schneider & Yin, 2012). Of the 23,003 students who earned a degree at an Arkansas four-year institution in 2013-2014, 49% were previously a degree-seeking student enrolled at a two-year institution (National Student Clearinghouse Research Center, 2015). The goal of Arkansas Act 672 of 2005 was to: "(1) identify and reduce barriers to enable students to reach the highest attainment level possible; (2) comply with statues that provide for seamless transfer; (3) reduce the number of individual articulation agreements by establishing a single statewide course transfer agreement that is simple, accessible, and student friendly; (4) provide an ongoing process for course transferability rather than a temporary fix; and (5) address course transfer issues identified by the Governor, legislators, institutions, and students" (Arkansas Department of Education, 2017). Subsequently, Arkansas Act 182 of 2009 was designed to "eliminate obstacles to transfers of credits among public institutions of higher education in Arkansas by providing a seamless transfer of academic credits from a completed designated transfer degree program to a baccalaureate degree program without the loss of earned credits…(p. 2)."

The implementation of Act 182 was specifically intended to increase the number of students transferring into four-year institutions and decrease the loss of credits transfer students had historically faced. Roksa and Keith (2008) reviewed statewide transfer policies and found that they failed to increase student degree obtainment. Smith (2010) estimated the courses students take that do not transfer and count toward their degree costs the students over $7 billion per year.

To meet the increased demand for STEM graduates, a concerted effort must be made by policymakers, educators and the business community to solve the challenges STEM students face when transferring from a TYC to a four-year institution. A piecemeal approach of laws, policies and programs has not produce the desired outcomes for Arkansas. Further analysis of the policies that lead to STEM educational attainment is needed to determine effectiveness. With the implementation of multiple state laws over the past decade aimed at increasing the success of transfer students, Arkansas has attempted to address the underlying issues. The question remains as to why the number of STEM graduates has not increased in Arkansas.

Statement of Purpose

This study reviewed the policies in the State of Arkansas and specifically the University of Arkansas aimed at improving the success of students transferring and graduating from four-year institutions to determine the effectiveness of these state policies. There is a need to increase STEM graduates in Arkansas, and this project focuses on STEM students entering the UA from other Arkansas TYCs. The policies reviewed included applicable state laws and university policies. The purpose for conducting the study will be to identify the effectiveness of Arkansas state transfer policies implemented to increase STEM degree attainment and increase the STEM workforce.

At the State's flagship institution of higher education in Fayetteville, UA students who transfer from two-year colleges are often an overlooked resource for STEM talent. A thorough review and evaluation of policies within the state of Arkansas, particularly at the University of Arkansas, is needed in order to take full advantage of all available resources, particularly for transfer students. Over the past decade, Arkansas has passed legislation aimed at addressing these transfer issues (Ar. S. Bill 247, 2005; Ar. H. Bill 1357, 2009). The study provides a much needed review and comprehensive evaluation of these transfer policies, particularly related to STEM students. By examining human and cultural capital in the communities STEM transfer students come from, specific recommendations for improvement can be made for both higher education institutions and state policy.

Research Questions

The need to increase STEM degree production and access to higher education are both issues receiving national attention. This study evaluates the nexus of these issues by assessing STEM transfer student success rates using the case of University of Arkansas and the State of Arkansas' policies. Specifically, the study will answer the following questions:

1. What is the profile of an average STEM transfer student into the University of Arkansas from a two-year Arkansas institution?
2. Are STEM transfer students graduating from the UA at the same rates compared to entering STEM freshman?
3. Since implementation of Arkansas Acts 182 and 672, both aimed at transfer student success, has the graduation rate of STEM transfer students increased at UA?
4. For STEM transfer students to UA, are there significant differences among select cultural and/or human capital variables?

5. What are the policy implications for UA and state leaders related to the findings?

Definitions

1. Arkansas Acts 182 and 672: In 2005, Arkansas passed Act 672 to “strengthen and expand transfer agreements among colleges and universities in Arkansas” (p. 1) by creating a state minimum core curriculum required to be offered at all public colleges and universities. The state minimum core curriculum was required to be accepted as transfer credit by other public institutions in Arkansas and the equivalencies to be published on each institution’s website. Arkansas Act 182 of 2009 expanded upon Act 672 by requiring: 1) four-year public institutions to accept all hours completed and credits earned by a student pursing a transfer degree at a two-year college in Arkansas toward their baccalaureate degree program at the four-year institution; 2) four-year institutions to develop transfer guidelines for each two-year institution within fifty miles; and 3) the four-year institution is not allowed to require additional lower level general education courses unless it is a prerequisite for an upper level course, a discipline-specific course, or is required by an accrediting body. Transfer degree programs at two-year colleges include associates of arts, science or arts in teaching.
2. Community Capitals Framework: The Community Capitals Framework is comprised of seven community capitals: natural, cultural, human, social, political, financial and built, which can be used to describe the strength, long-term well-being, and presence of a community (Flora & Flora, 2008). Community leaders often need to balance the growth or investment in one capital to avoid decreasing growth in a subsequent capital, potentially damaging the health of the community (Jacobs, 2007).

3. Cultural Capital: Cultural capital is the set of beliefs, values, worth, aspirations, social and economic factors that determine what knowledge is, how to achieve knowledge and how to validate knowledge (Flora, Flora, & Gasteyer, 2015).
4. Educational Attainment: The highest level of education an individual has received is referred to as educational attainment. In most studies, adults aged 25 years or over are the sample group (Kominski & Siegel, 1993).
5. Human Capital: Investments in education and training are considered human capital since separating people from their knowledge, skills or values is different from separating them from their financial and physical possessions (Becker, 2002). Human capital goes beyond formal educational attainment by including the knowledge, skills, leadership and potential of each person (Flora, Flora, & Gasteyer, 2015).
6. Science, Technology, Engineering and Mathematics (STEM): The acronym STEM is defined differently based on the perspective of the group using the term (Ramaley, 2009). In educational and research settings, a student pursuing a STEM degree is studying mathematics, chemistry, computer science, biological sciences, physics or engineering (Koonce, Zhou, Anderson, Hening, & Conley, 2011).
7. Transfer Student: For the study, a transfer student is defined as a person attending an Arkansas two-year college and transferring into a University of Arkansas STEM degree program.
8. Two-Year College: A two-year college, also known as a community college or junior college, is a public institution of higher education which awards an Associate degree as its highest degree (Cohen & Brawer, 2003). For the study, all of Arkansas' twenty-two public two-year colleges were included.

9. Underrepresented Minorities: In STEM, underrepresented minorities include African Americans, Hispanic or Latino Americans, Native Americans and Alaska Natives, and Native Hawaiians and Pacific Islanders who are US citizens or permanent residents (National Academies Press, 2011).

Limitations

1. This study explores STEM students who transfer into the University of Arkansas, the flagship, land-grant institution in Arkansas. UA has roughly 27,000 students with about half of the undergraduates coming from Arkansas. Studying only transfer students who come from Arkansas colleges limits the scope of the study. If other researchers attempt to replicate the study, other institutions might consider changing some of the variables based on their own state or institution's demographics.
2. Another limitation is how the Arkansas Department of Higher Education (ADHE) defines STEM majors and degrees. The study attempted to match the STEM degrees as close to the study's definition as possible, although it is possible that several career or technical majors at two-year colleges were not included in the study.
3. To date, researchers have not identified ways to repeatedly and accurately measure cultural capital within a community (Klamer, 2002). This study relied on various cultural capital variables that have been used in previous studies. The ambiguity in measuring cultural capital limits the study.
4. The researcher acknowledges *Research Question Two* could be more expansive by including a comparison of students from similar backgrounds. Tennant (2013) analyzed ACT scores, high school GPA, and college GPA at the 60 hour mark and determined little to no significant difference in persistence to graduation, with a four-year degree,

between students who start at two-year colleges and students who start at a four-year institution.

Significance of the Study

If Arkansas' STEM talent pool does not grow, the unmet demand for talented young scientists and engineers may lead employers to move their technology centers out of Arkansas, leaving the state further behind economically than the state currently is (ADHE, 2012). With the implementation of two state laws over the past decade aimed at increasing the success of transfer students, Arkansas has attempted to address the underlying issues. Arkansas has a critical need for more STEM graduates to fill the jobs the majority of Arkansans are not qualified to fill as only 26% of Arkansans have the minimally required associate's degree or higher (Complete College America, 2011).

Although the number of high school students entering the UA to pursue a STEM degree has increased over the past few years, transfer students are a pool of potential majors that should be expanded. For example, nearly half, or 44%, of students earning a baccalaureate engineering degree attended a community college at some time during their academic career (National Science Foundation, 2014). The UA is one of the most expensive four-year public institutions in Arkansas and students often need to attend another institution and transfer to UA to limit expenses. First generation and minority students are often more likely to attend a local institution before transferring to UA (National Academy of Sciences, 2011). To bridge the gap of STEM educational attainment, transfer students need to graduate in a reasonable amount of time following their transfer.

The recruitment of underrepresented groups into the STEM fields is essential to the future of the profession and the country to meet current labor demands while protecting the US

economic future. Community colleges are an essential component of the US STEM education system, enrolling 43% of US undergraduates (Provasnik & Planty, 2008). Minorities are disproportionately enrolled in community colleges with 52% being Hispanic students, 44% being African-Americans and 55% being Native Americans (Provasnik & Planty, 2008). Caucasian men have dominated the STEM professions; however, that population alone cannot meet these future labor demands in the US market. Hispanic students make up 5.2% of the college population in Arkansas, but only 0.9% are pursuing degrees in STEM; African-Americans make up 19.1% of the college population, but only 6.8% are in STEM degree programs (Complete College America, 2011).

The first three research questions will address the outcomes and outputs of the various state policies to determine their effectiveness. The fourth research question will evaluate if significant differences among select cultural and/or human capital variables exist for STEM transfer students. The differences might provide insight into the answers of research questions one through three for policymakers. The final research question will provide data that lead to policy recommendations to UA and state leaders to further increase STEM educational attainment for Arkansas STEM transfer students.

Theoretical Framework

Public policy is the government action toward a public issue, concern, or problem to which people seek answers and resolution (Shafritz, Layne, & Borick, 2005). With STEM jobs growing three times faster than non-STEM jobs, the lack of STEM talent in the US and Arkansas has US businesses concerned (Langdon et al., 2011). Employees in STEM-related fields are good for the health and economy of Arkansas as STEM workers earn 26% higher wages than their non-STEM counterparts (Langdon, McKittrick, Beede, Khan, & Doms, 2011). Through the

Community Capital Framework (CCF) and measuring the applicable seven community capitals, this study was designed to determine if underlying cultural and human capital constraints are inherently affecting STEM educational attainment of students who start at Arkansas two-year colleges with the intent of transferring to a four-year institution.

Previous studies have looked at a student's intent to transfer into a STEM field and identified several cultural capital factors such as parental education levels, family encouragement and access to institutional agents (Kruse, 2013; Jorstad, 2015). Interactions with institutional agents, academic advisors and counselors, as well as enrollment in previous math courses, are strong predictors of intention to transfer and pursue a STEM degree (Jorstad, 2015). These previous studies have focused on a student's intent to transfer to a four-year institution and pursue a STEM degree. However, this study includes select cultural and human capital variables of STEM students who actually transfer to a four-year institution. By reviewing the cultural capital STEM students receive, or inherit, from their two-year college community, local communities and families, and how race, gender, ethnicity and first-generation status affect cultural capital, this study will identify variables that determine success for STEM transfer students.

For the past several decades in the US, funding agencies, states and institutions have recognized the need to diversify their enrollments and this is increasingly important for STEM enrollments (Ryu, 2008; National Academy of Sciences, 2007). Efforts to increase the participation of underrepresented groups in STEM have been moderately successful, but for the US to produce the number of STEM degrees needed to fill workforce needs, the proportion of underrepresented graduates will need to triple (National Academy of Sciences, 2011).

Given that Arkansas is a rural state with large portions of the population below the poverty line, first generation and/or of ethnic minority, this study used select human and cultural capital variables to determine the likelihood a student would successfully transfer from a two-year college into UA and complete a STEM degree.

Chapter 2

Review of Related Literature

Introduction

This literature review is divided into four sections: 1) the history of STEM education and STEM education policy in the United States and Arkansas; 2) the challenges students who transfer from two-year colleges to four-year-universities face; 3) the unique challenges STEM students typically face when transferring from two-to-four-year institutions; and 4) human and cultural capitals as they relate to educational attainment.

History of STEM Education and Policy in US and Arkansas

Since 1990, the importance of increasing the number of STEM graduates has been well-documented (Williams, 2011). In 2012, the President's Council of Advisors on Science and Technology estimated one million more STEM graduates, beyond what is currently produced, will be needed in the US by 2022. With the US currently producing approximately 300,000 STEM graduates per year, an additional 100,000 graduates, or a 33% increase, would be needed to meet the demand (Olson & Riordan, 2012).

Why does the US need more STEM graduates?

A 2016 study produced by the National Science Foundation shows that while the number of science and engineering bachelor's degrees awarded has increased over the past 13 years, the proportion of STEM degrees compared to all degrees awarded has remained stagnant at 32%. While the number of degrees awarded in STEM fields has increased modestly when compared to the numbers in other first world nations, the US is woefully behind. For example, Japan awarded 57.2% of its degrees in STEM, China awarded 49.4%, Singapore awarded 41.8%, Canada awarded 35.7%, and Germany awarded 34.8% (National Science Foundation, 2016). In a global

economy dominated by STEM industries, this drastic contrast is by no means insignificant (Kennedy & Odell, 2014).

Increasing the number of STEM graduates is best summarized in *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (2007):

> It is easy to be complacent about US competitiveness and pre-eminence in science and technology. We have led the world for decades, and we continue to do so in many fields. But the world is changing rapidly, and our advantages are no longer unique. Without a renewed effort to bolster the foundations of our competitiveness, it is possible that we could lose our privileged position over the coming decades. For the first time in generations, our children could face poorer prospects for jobs, healthcare, security, and overall standard of living than have their parents and grandparents. We owe our current prosperity, security, and good health to the investments of past generations. We are obliged to renew those commitments to ensure that the US people will continue to benefit from the remarkable opportunities being opened by the rapid development of the global economy. (p. 223)

This leaves little doubt that a significantly larger and stronger STEM workforce is an unquestionable necessity to help maintain global competitiveness. Nevertheless, there remain large challenges to increase these numbers.

Underrepresented STEM enrollment.

For decades, the US has relied on Caucasian males to fulfill the STEM workforce needs, including 76% of the workforce in 2010 (Landivar, 2013). However, demographics in the US are shifting and underrepresented minorities will increasingly play a role in closing the STEM graduation gap. This challenge does not come without obstacles. According to a 2011 US Census report on STEM employment, 25.8% of the workforce employed in STEM occupations is female while 47.5% of the entire workforce is female. African Americans and Hispanics comprise 10.8 and 14.9%, respectively, of the total workforce while representing only 6.4 and 6.5, respectively, of the STEM workforce (Landivar, 2013). Higher education enrollment is comprised of 70% female or members of a minority group (Olson & Riordan, 2012). In STEM

fields, the same groups account for only 45% of the enrollment. To meet the demand for STEM students, this gap must be closed to be more inclusive (Olson & Riordan, 2012).

Lack of STEM degree enrollment.

Over the past decade, policymakers have made a concerted effort to increase STEM enrollment at both two- and four-year institutions. A 2005 study by the Government Accountability Office (GAO) reported that nearly $3 billion in federal funding was spent on increasing enrollment in STEM education in fiscal year 2004 (Kuenzi, 2008). When policymakers evaluate the impact of this funding, the numbers are deceiving. Engineers make up 32% of the STEM workforce and while engineering enrollment in higher education has increased 38.6% between 2000 and 2013, overall undergraduate enrollment has increased 32.8% during this same time (Landivar, 2013; National Science Foundation, 2016). The overall increase has led to an additional 150,902 college students currently being enrolled in engineering. However, due to particularly poor retention and graduation rates for engineering students, generating an additional 100,000 STEM graduates each year will require an even higher enrollment in engineering to compensate for attrition.

Poor retention in STEM degrees.

A 2010 study by the Higher Education Research Institute found students are pursing STEM degrees at a higher rate than previous studies have found (Higher Education Research Institute, 2010). Unfortunately, about half of the students who declared a major in, or intended to major in, STEM fields ultimately left STEM undergraduate programs and did not earn STEM degrees (National Center for Education Statistics, 2009). The first year of college is particularly important in terms of retention, as 35% of STEM majors changed their major after their first year (Daempfle, 2002). Students leave STEM fields for a number of reasons with the leading attrition

factors being lack of motivation, teaching techniques, study skills, rigid course sequencing, poor grades, uninspiring introductory courses, poor advising, and deficiencies in mathematics (Grimm, 2005; Matthews, 2012; Gilmer, 2007; Hanover Research, 2011; Lichtenstein, Loshbaugh, Claar, Bailey & Sheppard, 2007).

Regarding retention at the University of Arkansas, over the past 17 years, 1,804 students have transferred into the University of Arkansas' (UA) College of Engineering (COE) bringing in an average of 57.2 hours of transfer credit (UA Office of Institutional Research, 2016). The 3-year graduation rate for transfer students into COE is 28.0%; the four-year graduation rate is 43.7%. With 57.2 hours of transfer credit, students entering COE are juniors and should finish their engineering degree in 2-3 years. The number that is not included in this analysis is the number of students who started at another institution intending to transfer and complete an engineering degree and did not ultimately transfer.

Challenges of Students Transferring from Two-to-Four Year Institutions

Arkansas' TYCs represent an untapped population from which to recruit future STEM talent. Poverty is widespread in Arkansas (99% of students in the Arkansas Delta region receive free or reduced lunches), and TYCs offer a cost-effective way for many students from this poor state to complete their prerequisites before transferring to a university (State Education Data Center, 2006). The following section will detail many of the challenges students face when transferring from a two-year to a four-year institution.

The financial implications of low degree obtainment.

The retention and graduation rates of students who start at TYCs are historically low with approximately 20% completing a certificate or degree (Snyder & Dillow, 2011). Between 2004 and 2009, federal, state, and local taxpayers spent approximately $4 billion in appropriations and

student grants to first year TYC students who did not return for their second year (Schneider & Yin, 2011). The taxpayer contribution for students who are not retained is increasing substantially. In 2008-2009, nearly $1 billion was spent, which is a 35% increase since 2004 (Schneider & Yin, 2011). In Arkansas, the state and local expenditures on these students totaled $6.4 million in the 2008-2009 academic year. Unfortunately, the investment in students who did not continue their education continues to cost the federal, state, and local governments in multiple ways. First, given funding for higher education has stagnated or decreased over the past decade, spending precious resources on students who do not return decreases the pool of resources available to help students likely to succeed (Gillen, Robe, & Garrett, 2011). Second, decreased tax revenues impact future earnings for the state; if the local, state, and federal expenditures were better allocated and decreased the dropout rate by 50%, the return on investment would be considerable. The additional associate's degree graduates would generate an estimated $30 billion in income, which translates to an additional $5.3 billion in taxpayer revenue (Schneider & Yin, 2012).

Transfer shock.

Often, when students transfer from a smaller, more supportive two-year college into a much larger four-year institution, a drop in their grade point average (GPA) can be expected; this is often referred to as transfer shock (Hills, 1965). It could possibly been seen as students coming from two-year colleges are academically underprepared to pursue a four-year degree. Multiple studies have concluded two-year college transfer students experience a mean GPA decline of 0.08 to 0.60 when transferring (Cejda, 1997). Lakin and Elliott (2016) found STEM majors transferring from a TYC experienced the largest amount of transfer shock when entering a four-year institution. In a 1992 study of the transfer shock concept, 34% of students fully

recovered from their significant GPA drop to the level of other similarly majored students (Diaz, 1992). However, poor GPA performance after transferring is not solely a factor of academics preparation but also includes social factors that impede course success (Rhine, Milligan & Nelson, 2000).

Reverse transfer.

Reverse transfer agreements between TYCs and four-year institutions have increased in popularity across the US (Marling, 2012). A study by Friedel and Wilson (2015) provided a comprehensive overview of reverse transfer participation in all 50 states along with a review of best practices for implementing reverse transfers between institutions. The authors conducted an extensive literature review that provided the majority of data for analysis with questions or missing data obtained through qualitative methods. The term 'reverse transfer' refers to a student sending a transcript to a previous institution to obtain a degree or certificate. The most common form of reverse transfer is a student at a four-year institution sending a transcript to a TYC to earn an associate's degree, and this can also occur between four-year institutions. An example is UA COE students sending credits back to a previous four-year institution that does not offer engineering degrees to attain a math or science degree. Friedel and Wilson's (2016) study showed 18 states have no institutional or state reverse transfer policies/programs, 11 with no statewide policy but 3 or less institutions participating, and 21 states with statewide policies or 4 or more institutions participating in reverse transfer agreements. At the time of publication, the impact of the "degree awarded through reverse transfer on completion of the bachelor's degree is yet to be determined" (Friedel & Wilson 2015, p. 81).

Advising.

As with students who enroll in a four-year institution from high school, academic advising is a critical component of success for transfer students (Hagedorn, Cypers & Lester, 2008). This is demonstrated by the fact that academic course progression and completion along a transfer path is found to be more important in student success than personality characteristics (Hagedorn et al., 2008). At TYCs, more than half of all students enroll in at least one remedial course during their academic career (Horn, Nevill, & Griffith, 2006). Students are advised to progress through remedial coursework as quickly as possible to begin completing the course sequence for transfer (Packard, Gagnon & Senas, 2012). Often, a high student-to-academic counselor ratio leads to more students who "lack the understanding of transfer credits and students were not able to distinguish that the courses they were taking were three levels removed from a course that will provide transfer credit" (Hagedorn et al., 2006, p. 239).

Unique Challenges for STEM Students Transferring from Two-to-Four Year Institutions

A review of unique challenges STEM students face when transferring from a two-year to a four-year institution will allow for a better understanding of the issue of increasing STEM graduates.

Importance of two-year colleges to increase STEM enrollment.

A 2013 study indicated that 47% of recent STEM graduates attended a two-year college at some point during their bachelor degree studies (National Science Foundation, 2013). When asked why the STEM graduates attended a two-year college, the reasons included: earning credits toward STEM degree (31%); financial reasons (13%); increasing their chance of acceptance into a four-year STEM degree (12%); and completion of an associate's degree (8%) (National Science Foundation, 2013).

Looking at the various subpopulations of graduates who attended a two-year college, 50% were women; 51% were African American; and 57% were Hispanic (National Science Foundation, 2013). These numbers clearly demonstrate the need for a focus on two-year colleges and their students. If the US is going to increase the number of STEM graduates, students from two-year institutions will play a pivotal role in meeting this goal. Nevertheless, students intending to pursue a STEM four-year degree who start their academic career at a TYC are significantly less likely to achieve their goal (Wang, 2015). Researchers find this especially concerning as a higher percentage of underrepresented, financially-needy, and first-generation students begin at TYCs (Cohen & Brawer, 2003). Therefore, somewhat paradoxically, TYCs provide a large number of prospective STEM students that are widely diverse. Simultaneously, members of this same group are faced with a disproportionate set of distinctive challenges that make them at risk for failure to complete their degree or transfer to a four-year institution (Ornelas & Solorzano, 2004).

Arkansas reflects this enigma; for many Arkansas students, TYCs are the only economically feasible option for higher education. Poverty is widespread in Arkansas (99% of K-12 students in the Arkansas Delta region, for example, receive free or reduced lunches) and TYCs offer a cost-effective way for Arkansas' economically-disadvantaged students to complete their prerequisite coursework before transferring to a university (State Education Data Center, 2006). The numbers fail to reflect this, however, as few TYC students continue on to a four-year STEM degree program. Of the 120,545 students attending Arkansas' 22 TYCs in 2014, only 2,657 (2.2%) are enrolled in STEM degree programs (ADHE, 2015). Less than 1% of TYC students transfer to a University of Arkansas (UA) STEM program in any given year (Office of Institutional Research, 2016). Internal analyses reveal that, of those TYC students who did apply

to one of the UA STEM programs, less than 65% eventually enrolled in the University (2007-14) (Office of Institutional Research, 2016).

Reducing the cost of a STEM degree.

College Board (2014) found the percentage of students receiving Federal Pell Grants increased by 44%, from 25 to 36%, between 2007 and 2013. Federal grants are not enough for most students to achieve their degree as 60% of students who earned a bachelor's degree in the academic year 2011-2012 graduated with debt averaging $26,500 (College Board, 2014). The same study found 65% of STEM students had debt upon graduation. While parental financial support provides higher-income students the ability to focus on their studies, many students, especially in Arkansas, work to defer the cost of higher education. There is a strong correlation between the number of hours worked and a student's persistence in their STEM degree (ACE, 2005). Financial incentives, in combination with academic support, are the most effective way to increase retention and graduation among low-income students (National Academy of Sciences, 2011). Recently, several initiatives have been established in an attempt to control the costs of obtaining a college education. For example, a 2014 initiative in Tennessee, "Tennessee Promise," aims to provide free community college education to all high school graduates (Haslam, 2014). While the initiative is too new to determine its effectiveness, without proper support of STEM students, Tennessee will see a decrease in their retention and graduation of STEM students at two-year institutions.

Impacts of Performance-Based Funding.

The pressure on higher education to increase both enrollment and graduation rates has increased in recent years. As public funding has remained flat in the best of circumstances or substantially decreased, as it has in most states, institutions must increase their enrollment and

tuition rates in order to counter the historic decreases in public funding. At the same time, state legislatures are pushing universities to increase their four-year graduation rates-which have not increased in decades. In some instances the legislators are utilizing these desired increases as a means to determine the amount of public funding institutions will receive. The number of students nationwide enrolling in higher education after graduating from high school has increased from 45.9% in 1974 to 71.5% in 2004 (Horn, Berger, & Caroll, 2004). Unfortunately, the six-year graduation rate has remained stagnant at 66% during the same time period (Adelman, 2006).

The same pressures exist within higher education in Arkansas. Former Arkansas Governor Mike Beebe stated, “We can and must double the number of college graduates in Arkansas by 2025 if we are to stay competitive” (Arkansas 2025, 2011, p. 2). On April 5, 2011, Governor Beebe signed into law Act 1203, An Act to Promote Accountability and Efficiency at State-Supported Institutions of Higher Education; To Clarify Funding Formula Calculations for State-Supported Institutions of Higher Education. An underlying fault of Arkansas’ performance-based funding model is the rewarding of TYCs on degree productions when there exists a lack of foundational courses at TYCs needed prior to transferring to a four-year institution. TYCs are incentivized to keep a student at their institution pursuing a degree that has few transferrable courses toward their end goal of a STEM bachelor’s degree (Altstadt, 2012). Put simply, less-challenging courses lead to more students being able to graduate and the foundational STEM courses rarely fall into this category.

Lack of STEM foundational courses.

A phenomenological study looked at 172 STEM students and the delays the students experienced in transferring into a four-year STEM program (Packard, Gagnon & Senas, 2012).

Transfer students who answered “yes” on the question, “have you experienced any delay in your progress toward your transfer goals?” were interviewed about their delays in transitioning into a four-year STEM degree.

Findings from this study revealed three central elements which should be considered when evaluating UA transfer policies: 1) delays due to poor academic advising; 2) poor program alignment with four-year degrees; and 3) resource limitations of previous institution (Packard et al., 2012). In reviewing the resource limitation element, course scheduling, limited course offerings, and financial aid delays were the culprits. Many TYC students are unable to pursue STEM BS degrees due to the limited offerings of prerequisite or foundation courses at Arkansas' TYCs. Few TYCs currently offer STEM degrees or foundation STEM courses required for students to seamlessly transfer into a four-year STEM degree program. Presently, only two offer Calculus-based Physics. Such limited access to foundation STEM courses effectively curtails TYC students' pursuit of STEM degrees; only 12.8% of Associates degrees awarded at Arkansas TYCs were in STEM (Complete College America, Arkansas, 2011). The unique life circumstances including financial barriers, poor K-12 academic preparation and family demands often slow the academic progress of students at two-year colleges (Ornelas & Solorzano, 2004).

Internal UA College of Engineering (COE) data suggests that there is demand for STEM courses at TYCs. A recent UA COE survey of 762 Arkansas TYC students enrolled in math courses evaluated student interest in pursuing a four-year Engineering, Computer Science, Physics, Math, or Chemistry degree at the UA (Office of Institutional Research, 2016). Sixty percent of respondents indicated they would be interested in pursuing a four-year STEM degree. This increased to 73% if students were allowed to split their coursework (two years at a TYC plus two years at UA). When asked about barriers to pursuing a four-year STEM degree, 66% of

students identified ‘finances’ as the primary culprit, while 24% blamed limited course offerings at their TYC. Many respondents (24%) voiced a desire to take Calculus I online through UA. Other online courses that respondents desired include Chemistry (28%), Intro to Engineering (24%), University Physics (12%), and Differential Equations (11%). These results suggest that providing access to STEM foundation courses may increase STEM graduates at UA, while also increasing TYC retention and graduation rates.

STEM foundation courses at TYCs also improve first and second year student retention after transfer to a four-year college. COE experience has shown that TYC students transferring into engineering have an average of 41 transfer hours, yet only 51% have taken Calculus I - the first math course required of engineering students. Those students arriving without even basic Calculus have only a 36.8% chance of graduating with an engineering degree within six-years of transferring. It is undoubtedly disheartening to students with 40+ hours of college credits when advisors explain that they have four more years of study in order to graduate with an engineering degree. This makes providing the four-year readiness courses prior to arrival at UA unquestionably vital to increasing students’ likelihood of academic success.

STEM advising and transfer courses.

Academic advising is especially critical for students pursuing STEM degrees given the rigidity of the academic degree plans. Deliberate advising and transfer pathways are needed to educate students on the importance of continuous enrollment and progress toward courses that will transfer toward a STEM degree (Hagedorn et al., 2008). Alignment and communications between institutions is needed, particularly for sequenced STEM programs, to provide students the knowledge on transfer eligibility, course equivalencies and at what point during their academic program to transfer (Packard et al., 2012).

A STEM degree often has more required credit hours than other four-year degrees. Institutional transfer policies and practices are a leading factor in the success of STEM students. An institution must commit to support transfer students through adequate transfer process information and requirements, scheduling of classes, and transfer academic advising (Ornelas & Solorzano, 2004; Hagedorn et al., 2008). Articulation agreements, the policies between two institutions that govern the ability to transfer courses, is one example of alignment and communications between institutions that aid STEM transfer students (Zinser & Hanssen, 2006).

Human and Cultural Capitals as They Relate To Educational Attainment

Community Capitals Framework.

Each community, regardless if it is rural, isolated, urban, rich or poor, has assets, or resources, within it. These resources become capitals when they are invested to create new resources (Flora, Flora & Gasteyer, 2015). Beginning in 2008, Flora and Flora found the essence of a community can be explained by the strength of seven community capitals: natural, cultural, human, social, political, financial, and built (Flora & Flora, 2008). The ability of a community to balance the seven community capitals is critical. If a community emphasizes one capital over all of the others, the overall community health is damaged (Beaulieu, 2014).

Measuring a community's capital is often difficult (Putnam, 1998). Fey, Bregendahl and Flora (2006) state:

> The difficulty with measurement does not lie in finding forms of capital within a community; it is in finding a way to measure how capital is invested to affect a community's capacity (p. 2)…While we work to organize community elements under each form of capital and measure their change, we saw a lot of capital overlap: sometimes strong leadership is human and social and political capital: sometimes cultural capital is also human capital and natural capital. (p. 3)

The following sections aim to explain two of the community capitals used in this study in addition to the literature guiding the measurement of the capitals.

Cultural Capital.

One of the seven community capitals is cultural capital. Cultural capital refers to the educational, intellectual, social and value knowledge that is transferred over generations and an important contributing resource to someone's educational attainment (Bourdieu, 1977; Bourdieu & Passeron, 1990). Jaeger (2011) states "cultural capital is a scare resource which equips individuals with knowledge, practical skills, and a sense of 'the rules of the game' in the educational system which is recognized and rewarded by institutional gatekeepers and peers." (p. 1) Swidler's (1986) analysis of culture in action discusses a "tool kit" that shapes how culture is "used by actors, how cultural elements constrain or facilitate patterns of action..". (p. 284). It is within this "tool kit" that transfer students must find their cultural capital to persist and achieve a STEM degree.

Numerous studies have correlated the various measures of cultural capital with positive academic achievement and educational attainment (Sullivan, 2001; Crook, 1997; DiMaggio & Mohr, 1985; van de Werforst & Hofstede, 2007). Educational success and attainment is promoted through cultural capital by a parent sharing their beliefs with their children as a way to maintain the family class status and economic security (McDonough, 1998). While exclusive by nature, cultural capital is not a public resource easily measured (Kingston, 2001). De Graaf, De Graaf, and Kraaykamp (2000) found parental educational attainment to have an effect on the level of cultural capital of their children. Poverty does affect educational attainment. The participation of children in cultural activities (museums, concerts, library readings) has a statistically significant effect on academic achievement in high-income families but no effect in low-income homes (Jaeger, 2011).

Few studies have linked cultural capital and STEM educational attainment for transfer students. A 2016 study by Starobin, Smith and Laanan found female STEM transfer students aimed to improve their cultural capital through increased self-efficacy and improve their institutionalized cultural capital through positive interactions with STEM faculty, staff and advisors. Cultural capital is also developed when students consciously acquire, and passively inherit, one's beliefs through enrollment in a STEM field (Starobin, Smith & Laanan, 2016). Through academic preparation, institutional agents providing information and support networks, and increased self-efficacy, women in STEM can establish or increase their cultural capital (Perna et al., 2009; Jackson, 2010; Starobin & Laanan, 2005).

Human Capital.

While cultural capital is challenging to measure, human capital is far simpler. An investment that someone or a community makes in their education or training, health, or workforce is easily measured in terms of population statistics, educational attainment, job growth, home ownership rates, and a decreasing dependence on governmental services (Fey, Bregendahl & Flora, 2006). By investing in human capital, a community and an individual are able to increase their income earning potential (Becker, 1962). As communities realize the demand for STEM-related jobs is increasing, the community must expand the human capital credentials of their workforce by working with institutions of higher education to increase the skilled workers in their community (Landon, McKittrick, Beede, Khan, & Doms, 2011).

Beginning in 1971, research into the correlation between educational attainment and income inequality began to develop (Schultz, 1971). Schultz (1971) believed as a person invested in their human capital, their income earning potential increased, providing an avenue to acquire more property and pass down greater wealth to subsequent generations and thus decrease

the income inequality gap. The state of Arkansas provides a solid research base for studying human capital given the mixture of rural and urban communities, high and low unemployment areas, unequal distribution of educational attainment and wealth, and the lack of a skilled workforce to meet the workforce demands.

Chapter Summary

This chapter provided a thorough review of the relevant literature surrounding STEM education and policy and the challenges students face, particularly STEM students, when transferring from an Arkansas two-year college into a four-year institution. Research literature provided the academic, financial, and institutional challenges students are confronted with when transferring. Background literature related to the community capitals framework and how cultural and human capitals affect educational attainment.

Chapter 3

Methodology

Introduction

Increasing STEM degree production and access to higher education are both issues receiving national attention. This study evaluates the nexus of these issues by assessing STEM transfer student success rates using the case of the University of Arkansas and the State of Arkansas' policies. The following chapter will outline the methodology used to answer the following research questions:

1. What is the profile of an average STEM transfer student into the University of Arkansas from a two-year Arkansas institution?
2. Are STEM transfer students graduating from the UA at the same rates compared to entering STEM freshman?
3. Since implementation of Arkansas Acts 182 and 672 aimed at transfer student success, has the graduation rates of STEM transfer students increased at UA?
4. For STEM transfer students to UA, are there significant differences among select cultural and/or human capital variables?
5. What are the policy implications for UA and state leaders related to the findings?

Sample

The population in this study is students from Arkansas two-year colleges who transfer into the University of Arkansas to pursue a STEM degree. Arkansas currently has twenty-two two-year colleges enrolling students in degree-seeking and non-degree seeking programs. The *Annual Comprehensive Report 2015* (Arkansas Department of Higher Education, 2015) provides enrollment reports for all institutions of higher education in Arkansas. The Fall 2014 enrollment

at two-year colleges in Arkansas was 42,512. Since the study examines retention and graduation rates, UA's Office of Institutional Research provided historical data for all students seeking a STEM degree transferring from Arkansas two-year colleges since 2000 which totaled 704 students. The sample was 27.4% female, 81.5% Caucasian, 2.0% African American, 8.8% Hispanic, 1.4% Native American, 1.6% Two or More Ethnicities, and 2.3% Asian or Pacific Islander. Of the 704 students, 635 had a record for first-generation status with 52.8% indicating first-generation to college.

Data Collection

The data collected for this study came from existing databases at the Arkansas Department of Higher Education, the University of Arkansas' internal student information system, the National Science Foundation's Science and Engineering Indicators Annual Report and the US Census Bureau. As part of an ongoing research project on students transferring from two-year colleges, previous data has been collected with approval by the University of Arkansas Institutional Review Board (IRB #12-09-112). To conform with UA policy, a separate IRB protocol approval was submitted for this dissertation, IRB #17-02-440 and is included in Appendix E.

As outlined in subsequent sections, the data collected for the study was done *ex post facto* (or after the fact) and removed the possibility of participants' knowledge of their data being used in the study (Anastas, 1999).

The following sections outline the data collected for each research question:

Research Question One: What is the profile of an average STEM transfer student into the University of Arkansas from a two-year Arkansas institution?

To collect data for Research Question One, UA's internal student information database, *UAConnect*, was utilized to pull the following information on each student who transferred into a UA STEM degree program (2016):

1) First generation status: When applying to the University of Arkansas, students must check if their father and/or mother received a bachelor's degree.
2) Student personal information: Data including age, gender, ethnicity and the Arkansas county where the student graduated high school.
3) Previous educational history: Data including high school ACT and grade point average, the cumulative transfer grade point average and the highest mathematics course transferred into UA.

Research Question Two: Are STEM transfer students graduating from the UA at the same rates compared to entering STEM freshmen?

To collect data for Research Question Two, UA's internal student information database, *UAConnect*, was utilized to pull the following information on each student who transferred into a UA STEM degree program. Comparative graduation rates for entering new freshman from the same year was attained online through UA's Office of Institutional Research website (2016):

1) Graduation rates: Data on whether or not a STEM transfer student graduated from the UA and, if so, with what degree, within three- or five-years from entering the UA. Data on UA STEM freshmen students will also be calculated for those graduating within four or six years from the time they entered the UA.

Research Question Three: Since implementation of Arkansas Acts 182 and 672 aimed at transfer student success, have the graduation rates of STEM transfer students increased at UA?

To collect data for Research Question Three, UA's internal student information database, *UAConnect*, was utilized to pull data on whether or not a STEM transfer student graduated with a UA STEM degree within three or five years from entering from the UA. This will be calculated over fifteen year period (2000-2015).

Research Question Four: *For STEM transfer students to UA, are there significant differences among select cultural and/or human capital variables?*

To collect data for Research Question Four, select independent variables for Arkansas counties was pulled from the US Census Bureau, the US Bureau of Labor Statistics and the Arkansas Department of Higher Education. In addition, select independent variables for Arkansas two-year colleges were pulled using each institution's website and the latest published catalog of study. Dependent variable information was obtained from the Arkansas Department of Education's website and information was received directly from the Arkansas Department of Higher Education.

Data from the US Census Bureau for each county in Arkansas included:

1) Poverty rate (2009-2013).
2) Bachelor's degree attainment for residents over 25 years old (2009-2013).
3) Median household income (2009-2013).

Data was also pulled from the US Bureau of Labor Statistics for each Arkansas county's employment rate (2015).

The college-going rate per Arkansas county was obtained through the Arkansas Department of Higher Education (2011-2015).

Institutional data was pulled from each two-year college's website and catalog of studies. For each county in Arkansas, the two-year college located in the county was used in the analysis. Data pulled from each two-year college includes:

1) Course offerings in advanced mathematics (ex. Calculus I, II and III) geared toward STEM majors.
2) Presence of an academic advising center.
3) Presence of a transfer center aimed at increasing the cultural capital of STEM transfer students (Laanan, Starobin & Eggleston, 2010).

Research Question Five: What are the policy implications for UA and state leaders related to the findings?

Research Question Five is an analysis on transfer policies to determine any policy recommendations that might exist for UA and state of Arkansas policymakers. The community capitals framework was used in this study to identify communities which are lacking in cultural and/or human capital and the effect the deficiencies have on STEM degree attainment through the two to four-year college transfer path.

Content Validity and Reliability

The study used published and protected data to answer the five research questions over a time period of fifteen years. Reliability is mostly a concern when administering surveys and in qualitative studies and was not a concern in this study.

Content validity, on the other hand, must be considered given the concept of community capitals used in the study because each acts independently in measurement. While there are various ways to determine validity, utilizing the previous research that experts in the field have

published can help establish validity (Creswell, 2013). Below are the independent variables used to answer Research Question Four surrounding human and cultural capitals:

1) Poverty rate, employment rate and median household income: Decreasing income inequality and increasing an individual's earning potential through increasing human capital began to be studied by Becker (1962). By increasing human capital, a community is able to simultaneously increase the employment rate and household income and decrease the poverty rate.
2) Bachelor's degree attainment and college-going rate: Researchers have used college-going rate and bachelor's degree attainment as strong measures of both cultural and human capital (De Graff et al., 2000; Becker, 1962). Educational attainment has a positive impact on subsequent generations and earning potential. A lack of parental educational attainment, or the lack thereof, has shown first-generation students do not have the cultural capital to understand the college environment (Berger et al., 2013).
3) Mathematics course offerings: While many studies have focused on a student's GPA in high school or college, Kruse (2013) found the higher the college-level mathematics course a student successfully completed at the college level, the higher the likelihood of a student transferring into a STEM four-year degree.
4) Academic advising: Kruse (2013) found access to community college advising to be the most significant factor in whether or not a student transfers into a four-year STEM degree. The importance of institutionalized cultural capital through positive interactions with faculty, staff and advisors encourages students to obtain the knowledge needed to successfully graduate with a STEM degree.

5) Transfer centers: Providing institutional agents and support networks to STEM students who are considering transferring to a four-year institution has been a strong indicator of cultural capital (Perna et al., 2009).

Data Analysis

This research utilized quantitative analysis for research questions one through four, with qualitative methodology used for the final research question. The study employed IBM's SPSS version 23 in the data analysis for the first four research questions. Research question one utilized descriptive statistics, including frequencies, to determine the background and demographic characteristics of STEM transfer students coming into the UA from an Arkansas two-year college. Research question two aimed to determine whether or not STEM transfer students were graduating from the UA at comparable rates to entering UA STEM freshman. Overall graduation percentage and frequency was obtained for both. Research question three divided the UA STEM transfer student graduation rates into three time periods. The first, 2000 to 2005, is prior to the enactment of Act 672. The second, 2006 to 2010, is between when Act 672 was enacted and before Act 182 was enacted. The final, 2011 to 2012, is after Act 182 was enacted. For each time period, three- and five-year graduation rates and frequencies were calculated.

Research question four utilized a weighted least squares (WLS) regression for data analysis. A regression analysis was chosen to explain the proportion of STEM transfer students entering UA from each county in Arkansas based on selected independent human and cultural capital variables. WLS was chosen due to its ability to efficiently handle smaller sample sizes compared to other regression models (Iacobucci, 2010). In addition, heteroskedasticity, or unequal scatter of uncorrelated errors, is avoided through the use of WLS over other regression

models, to help equalize the dependent variable's variability across values of each independent variable (Carroll & Ruppert, 1982). One issue of importance in using WLS is to ensure the weights can be estimated precisely relative to each other to avoid unpredictability in the analysis (Carroll & Ruppert, 1982).

Research question five analyzed the goals of Acts 182 and 672 to determine if each achieved the desired effects when passed into law. In particular, did the streamlining of transfer credits and collaboration between institutions of higher education in Arkansas increase the number of students transferring to and graduating from a four-year institution with a STEM degree?

Research Question One: What is the profile of an average STEM transfer student into the University of Arkansas from a two-year Arkansas institution?

Fifteen years of data (2000-2015) was collected on students transferring from two-year Arkansas institutions into UA. Descriptive statistics, including frequencies, means, standard deviations and ranges representative of the entire data set were reported per data category.

Research Question Two: Are STEM transfer students graduating from the UA at the same rates compared to entering STEM freshman?

Similar to Research Question One, fifteen years of data (2000-2015) was collected on students transferring from two-year Arkansas institutions into UA STEM degrees in addition to incoming UA STEM freshman data. Transfer STEM students are compared to UA STEM freshman in overall percentage and frequency of graduation. The raw data was provided by UA's Office of Institutional Research for analysis.

Research Question Three: Since implementation of Arkansas Acts 182 and 672 aimed at transfer student success, has the graduation rates of STEM transfer students increased at UA?

Three- and five-year UA graduation rates of STEM transfer students were used in *Research Question Three.* The study used three- and five-year graduation rates since all of the students transferred in at least 24 hours of college credit into the UA. Similar with Research Question One and Two, fifteen years of data (2000-2015) was collected on students transferring from two-year Arkansas institutions into UA STEM degrees. The raw data was provided by UA's Office of Institutional Research for analysis.

Three time periods were considered: students entering UA in the years prior to Act 672 (2000-2005), students entering UA in the years after Act 672 and prior to Act 182 (2006-2010) and students entering UA in the years after Act 182 (2011-2012) provided an overall mean for each time period.

Research Question Four: For STEM transfer students to UA, are there significant differences among select cultural and/or human capital variables?

To answer Research Question Four, a weighted least squares regression was utilized. The dependent variable was the rate of STEM transfer students (2000-2015) entering UA when compared to the mean number (2010-2015) of students entering college from each county in Arkansas. The college-going rate per Arkansas county was used as the model's weight (2010-2015). The independent variables for the model from each Arkansas county included: poverty rate, bachelor's degree attainment, median household income, employment rate, highest mathematics course offered at a two-year college, academic advising center offered at a two-year college, and a transfer center at a two-year college.

Research Question Five: What are the policy implications for UA and state leaders related to the findings?

An analysis of the findings from research questions one through four was used to answer research question five. By examining the goals of Acts 182 and 672, the study will determine if each act achieved the desired effects and to provide policy recommendations to UA, two-year colleges and state of Arkansas leaders.

Chapter Summary

This chapter outlined the methodology used in the study in an attempt to answer the five research questions. The sample included students who transferred from a two-year college in Arkansas into the University of Arkansas to pursue a STEM degree. The study evaluates the nexus of issues surrounding STEM transfer student success rates using the case of the University of Arkansas and the State of Arkansas' policies. A combination of descriptive statistics, quantitative research analysis using ANOVA and WLS, and finally a qualitative analysis from the findings was used to determine why more STEM transfer students are not completing degrees and entering the workforce.

Chapter IV

Data Analysis

Introduction

Following the implementation of legislation passed in 2005 and 2009, Arkansas intended to increase the number of students transferring into four-year institutions and decrease the loss of credits transfer students had historically faced. A thorough review and evaluation of policies within the state of Arkansas, particularly at the state's flagship campus, the University of Arkansas, is needed in order to take full advantage of all available resources, particularly transfer students. The study provides a review and comprehensive evaluation of these transfer policies, particularly related to STEM students. By examining human and cultural capital in the communities STEM transfer students come from, specific recommendations can be made for both higher education institutions and state policy. This chapter includes how the data were collected, data analysis and results, and a chapter summary.

Data Collection and Considerations

UA's internal student information database, *UAConnect*, was utilized to pull information on each student who transferred into the UA from a two-year college in Arkansas. A detailed data request was provided to UA's Office of Institutional Research which provided the raw data from *UAConnect* on all Arkansas students who transferred at least 24 hours of credit from an Arkansas two-year college. A unique identification number was assigned to each student to allow for tracking throughout the study. By limiting the study to only students with at least 24 hours of transfer credit, the study eliminated students who might only have taken a course or two over the summer at a local two-year college. Additional data were collected from the US Census Bureau, the US Bureau of Labor Statistics, and the Arkansas Department of Higher Education.

Data Analysis and Results

Research Question One.

What is the profile of an average STEM transfer student into the University of Arkansas from a two-year Arkansas institution?

Information pulled from *UAConnect* was used to create descriptive statistics regarding STEM transfer students into UA from Arkansas two-year institutions. Table 1 includes descriptive statistics on the entire population (2000-2015) of STEM transfer students in terms of first generation status, student age, gender, ethnicity, high school ACT and GPA, cumulative transfer GPA, number of hours transferred into UA, and first UA math mathematics course. The original file provided by the UA's Office of Institutional Research included 705 students. The data were reduced to only students who transferred from Arkansas two-year colleges resulting in 434 students.

Table 1

Descriptive statistics on UA STEM transfer students

Variable	Categories Percent (*n*)				
First generation	Yes 34.8% *(151)*	No 46.5% *(202)*	Missing 18.7% *(81)*		
Age	18-24 84.8 *(368)*	25-29 10.4 *(45)*	30-39 3.9 *(17)*	40-55 0.09 *(4)*	>55 0.0 *(0)*
Gender	Male 77.6 *(337)*	Female 22.4 *(97)*			

Table 1 (continued)

Descriptive statistics on UA STEM transfer students

Variable	Categories Percent (*n*)				
First generation	Yes	No	Missing		
Ethnicity	African American	American Indian	Asian/Pacific Islander	Caucasian	Hispanic
	1.2 *(5)*	0.9 *(4)*	2.8 *(12)*	87.3 *(379)*	4.4 *(19)*
	Two or More	Non-Resident Alien	Unknown		
	0.7 *(3)*	0.9 *(4)*	1.8 *(8)*		
High School ACT	≤20	21-24	25-28	29-31	32-36
	17.1 *(74)*	30.9 *(134)*	22.6 *(98)*	5.8 *(25)*	1.1 *(5)*
	Missing ACT				
	22.6 *(98)*				
High School GPA	≤3.0	3.01-3.4	3.41-3.75	3.76-4.0	>4.0
	14.7 *(64)*	12.4 *(54)*	19.3 *(84)*	13.1 *(57)*	1.6 *(7)*
	Missing GPA				
	38.7 *(168)*				
Transfer GPA	≤3.0	3.01-3.4	3.41-3.75	3.76-4.0	Missing
	37.1 *(161)*	26.3 *(114)*	14.8 *(79)*	16.1 *(70)*	2.3 *(10)*
Transfer Hours	≤30	31-45	46-60	61-90	>91
	19.6 *(85)*	26.5 *(115)*	29.7 *(129)*	22.4 *(97)*	1.8 *(8)*
First UA Math course	<College Algebra	College Algebra	Trigonometry	PreCalculus	
	1.6 *(7)*	2.3 *(10)*	10.1 *(44)*	9.2 *(40)*	
	Calculus I	Calculus II	>Calculus II	Other	No math
	24.9 *(108)*	8.5 *(37)*	8.8 *(38)*	21.0 *(91)*	13.6 *(59)*

Note. Data provided by UA’s Office of Institutional Research (2000-2012).

Reviewing the data on STEM transfer students, there were less underrepresented minority students transferring into UA than starting as UA STEM new freshman. Only 7.1% of the STEM transfer students were underrepresented minorities compared to 12.0% of new STEM freshman. This is not consistent with two-year colleges, which have a higher percentage, 39.0%, of underrepresented minority students compared to 24.1% at four-year public institutions (Arkansas Department of Higher Education, 2015).

The average high school GPA and composite ACT score were also lower than new freshman. New freshman had an average high school GPA of 3.7 and a 27.4 ACT compared to 3.2 high school GPA and 21.3 ACT for STEM transfer students. This is important to note as many of these students attending a two-year college would need remediation in Math courses prior to taking higher level mathematics courses, like Calculus I.

In UA's College of Engineering, the eight-semester plan begins with Calculus I as the first Math course. In looking at only transfer students entering the College of Engineering, 72 (26.5%) began in a course below Calculus I and 75 (27.6%) started in Calculus I. For students starting in their first math course below Calculus I, the average number of hours transferred into UA was 37.3. In answering Research Question One, the profile of the average STEM transfer student is a Caucasian male with a High School GPA and ACT lower than those typically admitted into UA and behind in their mathematics courses.

Research Question Two.

Are STEM transfer students graduating from the UA at the same rates compared to entering STEM freshman?

Similar with Research Question One, 15 years of data (2000-2015) were collected on students transferring from two-year Arkansas institutions into UA STEM degrees and entering

UA STEM freshman in overall graduation percentage and frequency. Transfer graduation rates were calculated for students three and five years after starting at UA. To calculate three-year graduation rates, transfer students entering UA between 2000 and 2012 were considered. Likewise, five-year graduation rates included transfer students who entered between 2000 and 2010. Four and six-year graduation rates were calculated for UA STEM freshman. Four-year graduation rates included new freshman entering between 2000 and 2011 with six-year graduation rates including students entering between 2000 and 2009.

Utilizing the STEM transfer student data from *UAConnect*, the study calculated whether or not a student graduated from a STEM degree in three and/or five years after entering the UA. The data below includes transfer students who entered UA in one STEM degree and graduated from that same STEM degree (same STEM), any STEM degree (any STEM), any UA degree (non-STEM), or did not graduate (No Grad). Table 2 provides the transfer student graduation statistics. The data set included a total of 434 students who entered between 2000 and 2012 and 347 transfer students who entered between 2000 and 2010.

Table 2

Transfer graduation statistics

Variable	Grad. in 3-years Percent (*n*)	Grad. in 5-years Percent (*n*)
Graduation		
Same STEM	23.7% *(103)*	35.2% *(122)*
Any STEM	1.2 *(5)*	1.2 *(4)*
Non-STEM	7.8 *(34)*	14.9 *(52)*
No Grad	67.3 *(292)*	48.7 *(169)*

Note. Data provided by UA's Office of Institutional Research (2000-2012).

In calculating a comparable rate for entering STEM freshman, UA's Office of Institutional Research (OIR) provided a graduation report that contained student data from 2000 to 2015 from *UAConnect*. The study totaled the number of STEM students who began as new freshman between the years of 2000 and 2009 to calculate six-year graduation rates and 2000 to 2011 to calculate four-year graduation rates. The OIR graduation rates were based on students who started in a STEM degree and finished in that same STEM degree. A second analysis was done on students who started in a STEM degree and finished in another STEM degree or any UA degree. A total of 4,240 students entered between 2000 and 2009 and 5,408 between 2000 and 2011. Table 3 provides new STEM freshman graduation rates.

Table 3

UA STEM new freshman graduation statistics

Graduation Rates	4-years Percent (*n*)		6-years Percent (*n*)	
Graduation				
Same STEM	26.1%	*(1410)*	33.7%	*(1428)*
Any STEM	4.0	*(218)*	6.7	*(284)*
Non-STEM	13.1	*(708)*	21.2	*(898)*
No Grad	56.8	*(3072)*	38.4	*(1630)*

Note. A student that selected a Bachelor of Arts degree in one STEM field and graduated with a Bachelor's of Science in that same STEM field is considered "Same STEM" as many students do not understand the difference between a Bachelor's of Arts and Bachelor's of Science degree when entering from high school. Conversely, a student that entered under a Bachelor's of Science degree in one STEM field and graduated with a Bachelor's of Arts in that same STEM field is considered "Same STEM" for the study. Similarly, a student that entered in one STEM field and graduated with an honors degree in that same STEM field is considered "Same STEM" for the study. Data provided by UA's Office of Institutional Research (2000-2012).

Tables 2 and 3 show that there are considerable differences between the graduation rates when looking at STEM transfer students and STEM new freshman. Nearly half, 48.7%, of

STEM transfer students did not graduate from the University of Arkansas within five years of entering. In comparing the STEM transfer students to the new freshman, there is concern for students who begin their UA academic career with their first math course below Calculus I. With students entering the College of Engineering, specifically, transfer students who began in less than Calculus I had a 5-year graduation rate in the same STEM field of 16.7% with 56.9% of students not graduating in 5-years. In answering Research Question Two, the graduation rates of STEM transfer students are less than those of STEM entering freshmen at the UA.

Research Question Three.

Since implementation of Arkansas Acts 182 and 672, aimed at transfer student success, have the graduation rates of STEM transfer students increased at UA?

Research Question Two showed STEM transfer students graduate at lower rates than new freshman. In order to determine if the graduation rates changed post-implementation of Acts 182 and 672, a review of each time period was performed: students entering UA in the years prior to Act 672 (2000-2005), students entering UA in the years after Act 672 and prior to Act 182 (2006-2010) and students entering UA in the years after Act 182 (2011-2012). Table 4 shows the transfer graduation statistics for each time period.

Table 4

Transfer graduation statistics for each time period

Variable	Grad. in 3-years Percent (*n*)		Grad. in 5-years Percent (*n*)	
Pre-Act 672 (2000-2005)				
Same STEM	26.7%	*(58)*	35.5%	*(77)*
Any STEM	0.0	*(0)*	0.0	*(0)*
Non-STEM	6.5	*(14)*	17.1	*(37)*
No Grad	66.8	*(145)*	47.5	*(103)*
Between Acts 672 and 182 (2006-2010)				
Same STEM	20.0	*(26)*	34.6	*(45)*
Any STEM	3.1	*(4)*	3.1	*(4)*
Non-STEM	10.0	*(13)*	11.5	*(15)*
No Grad	66.9	*(87)*	50.8	*(66)*
Post-Act 182 (2011-2012)				
Same STEM	19.5	*(17)*	28.7	*(25)*
Any STEM	1.1	*(1)*	3.4	*(3)*
Non-STEM	8.0	*(7)*	19.5	*(42)*
No Grad	71.3	*(62)*	48.3	*(42)*

Note. The table included when a student entered the UA to pursue a STEM degree, not when the student started at the TYC.

Arkansas' Act 672 goal was the identification and reduction of barriers transfer students typically face when moving between institutions. In reviewing the three- and five-year graduation rates in Table 4, for students graduating with the same STEM degree they entered the UA to pursue, the graduation rates dropped after Act 672 was passed. The rates continued to drop after Act 182 was passed in 2009. Prior to Act 672, the transfer graduation rates were the highest followed by the period between Acts 672 and 182. Overall, more STEM transfer

students failed to graduate from the UA with a degree after both Acts were implemented than before the implementation of the Acts.

Research Question Four.

For STEM transfer students to UA, are there significant differences among select cultural and/or human capital variables?

Research Question Four sought to explain if select cultural and/or human capital variables explained the differences in the graduation rates from Research Question Three. Research Question Three showed the three- and five-year graduation rates for STEM transfer students decreased after Act 672 and 182 were implemented.

Dependent Variable for WLS Regression.

To answer Research Question Four, a weighted least squares (WLS) regression was utilized to understand to what extent select cultural and/or human capital variables affected the success of a two-year college student transferring into a UA STEM degree. The dependent variable was the proportion of STEM transfer students (2000-2015) entering UA from each county in Arkansas when compared to the mean number (2010-2015) of students entering college from each county in Arkansas. The college-going rate per Arkansas county was used as the model's weight. The independent variables for the model from each Arkansas county included: poverty rate, bachelor's degree attainment, median household income, employment rate, highest mathematics course offered at a two-year college, academic counseling and/or advising center offered at a two-year college, and a transfer center at a two-year college.

The dependent variable, the rate of STEM transfer students entering UA from each Arkansas county, was determined based on 2000-2015 data from *UAConnect* along with data from the Arkansas Department of Higher Education (ADHE). The ADHE website only included

the number of high school graduates pursuing full-time enrollment for academic year 2014. In consultation with ADHE, data were provided for academic years 2010-2015 for analysis. An Excel file was created combining all six years of college-going data. A mean number of high school graduates attending full-time enrollment the subsequent fall was calculated for each Arkansas county (2010-2015). Given the significantly low number of students transferring into UA STEM degrees from each county, the transfer participation rate is the total number of UA STEM transfer students from each county (2000-2012) divided by the mean full-time enrolled high school graduates from each county (2010-2015). Twenty-nine of the seventy-five counties in Arkansas had zero students enter UA STEM degree programs between 2000 and 2012. Table 5 provides a sample of the data for one Arkansas county, Faulkner. Detailed information is located in Appendix A.

Table 5

Sample data for transfer participation rate per Arkansas county

County	Mean Full-Time Enrolled HS Graduates	Number of UA STEM Transfer Students	Transfer Participation Rate
Faulkner	684	16	0.023

Note. Mean Full-Time Enrolled HS Graduates obtained through Arkansas Department of Higher Education. Records were published though not archived online (2010-2015). Number of UA STEM Transfer Students provided through UA's Office of Institutional Research (2000-2012).

For the models' weight, the college-going rate was determined through the percentage of students enrolling in a postsecondary institution in the fall semester immediately after completing high school. For the study, 2010-2015 data were used to create an annual percentage for each Arkansas county using ADHE data. In Excel, the total number of high school graduates (2010-2015) were added together. In a separate column, the total number of full-time enrolled

students was added together. The combined college-going rate was a simple function (full-time students / high school graduates). One note of importance is ADHE only reports on the public high school graduates which excludes students graduating from private schools or those who were home schooled.

Table 6 provides a sample of the data for Faulkner County. Detailed information found in Appendix B.

Table 6

Sample data for college-going rate per Arkansas county

County	Total High School Graduates	Total Full-Time Students Enrolled	College-Going Rate
Faulkner	6704	4105	61.2%

Note. Total High School Graduates and Total Full-Time Students Enrolled obtained through Arkansas Department of Higher Education. Records were published though not archived online (2010-2015).

Independent Variables for WLS Regression.

Research Question Four's independent variables for the model from each Arkansas county included: poverty rate, bachelor's degree attainment, median household income, employment rate, highest mathematics course offered at a two-year college, academic counseling and/or advising center offered at a two-year college, and a transfer center at a two-year college. Data from the US Census Bureau and US Bureau of Labor Statistics were pulled directly from their websites and compiled into Excel worksheets and imported into SPSS. Importing an entire Excel workbook is not supported by the SPSS software. The data collected from the US Census Bureau for each county in Arkansas included the poverty rate, bachelor's degree attainment and

median household income from 2009-2013. The US Bureau of Labor Statistics' website provided the employment rate for each Arkansas county (2015).

Several of the cultural capital variables were not easily accessible in table form and required manual input. The highest mathematics course offered per year, the existence of an academic counseling and/or advising center, and the existence of a transfer center for each two-year college had to be determined through web searches. This data collection happened over the course of a week and was inputted manually into an Excel worksheet. Table 7 provides the SPSS codes the study used for each independent variable. Information on each county's independent variables is available in Appendix C.

Table 7

Independent variable SPSS codes

Code	Explanation
BachelorDegreeAttainment	Percent Bachelor's degree attainment, 25 years or older, 2009-2013
PovertyRate	Percent population below poverty line, 2009-2013
MedianHouseholdIncome	Median household income, 2009-2013
EmploymentRate	Unseasonably adjusted unemployment rate, 2015
Math	Highest mathematics course in nearest two-year college (2016-2017)
AcadCou	Presence of academic advising center at two-year college (2016-2017)
Transfer	Presence of transfer center at two-year college (2016-2017)

Table 8 shows the results from the WLS regression.

Table 8

Weighted Least Square Regression analysis for select human capital variables

Independent Variable	Unstandardized Estimate *(B)*	Std. Error	Standardized Coefficients *(Beta)*	*t*
(Constant)	5.822	7.081		0.822
EmploymentRate	-0.726	0.384	-0.245	-1.893
MedianHouseholdIncome	0.00004998	0.000	0.091	0.368
BachelorDegreeAttainment	-0.076	0.110	-0.111	-0.688
PovertyRate	0.002	0.130	0.002	0.012

Note. Adjusted $R^2 = 0.018$; *df* = 74. No variables reach statistical significance of $p \leq 0.05$.

The WLS analysis found that 1.8% of the variability in the dependent variable, STEM transfer participation rate, could be explained by the independent variables. Typically, a R^2 value below 0.2 is a weak explanation of the variability in the dependent variable. The WLS found the coefficient of employment rate and bachelor degree attainment to be negative, meaning the STEM transfer participation rate will decrease as the county's employment and bachelor degree attainment percentages increase. None of the independent variables reached $p \leq 0.05$ for statistical significance. As none of the independent variables are statistically significant, and a F-statistic of 1.33 is small, we cannot reject the hypothesis that the independent variables explain the variation in STEM transfer participation rates.

With four independent variables in the WLS regression model, the study needed to determine if multicollinearity existed. Collinearity tests were performed on the WLS model. The summary results are found in Table 9.

Table 9

Summary of collinearity statistics for Weighted Least Square Regression for select human capital variables

Independent Variable	Tolerance	VIF
(Constant)		
EmploymentRate	0.795	1.259
MedianHouseholdIncome	0.219	4.572
BachelorDegreeAttainment	0.509	1.963
PovertyRate	0.337	2.968

Note. Potential collinearity if Tolerance ≤ 0.20 and/or VIF ≥ 5.00

In reviewing the collinearity results, none of the independent variables reached a tolerance level below 0.20 nor a VIF above 5.0, signifying no collinearity exists.

In reviewing the selected cultural capital variables, there was limited quantitative data to analyze. Figure 1 below shows the STEM transfer participation rates for each Arkansas county with a “star” symbol for each Arkansas two-year college located within a county.

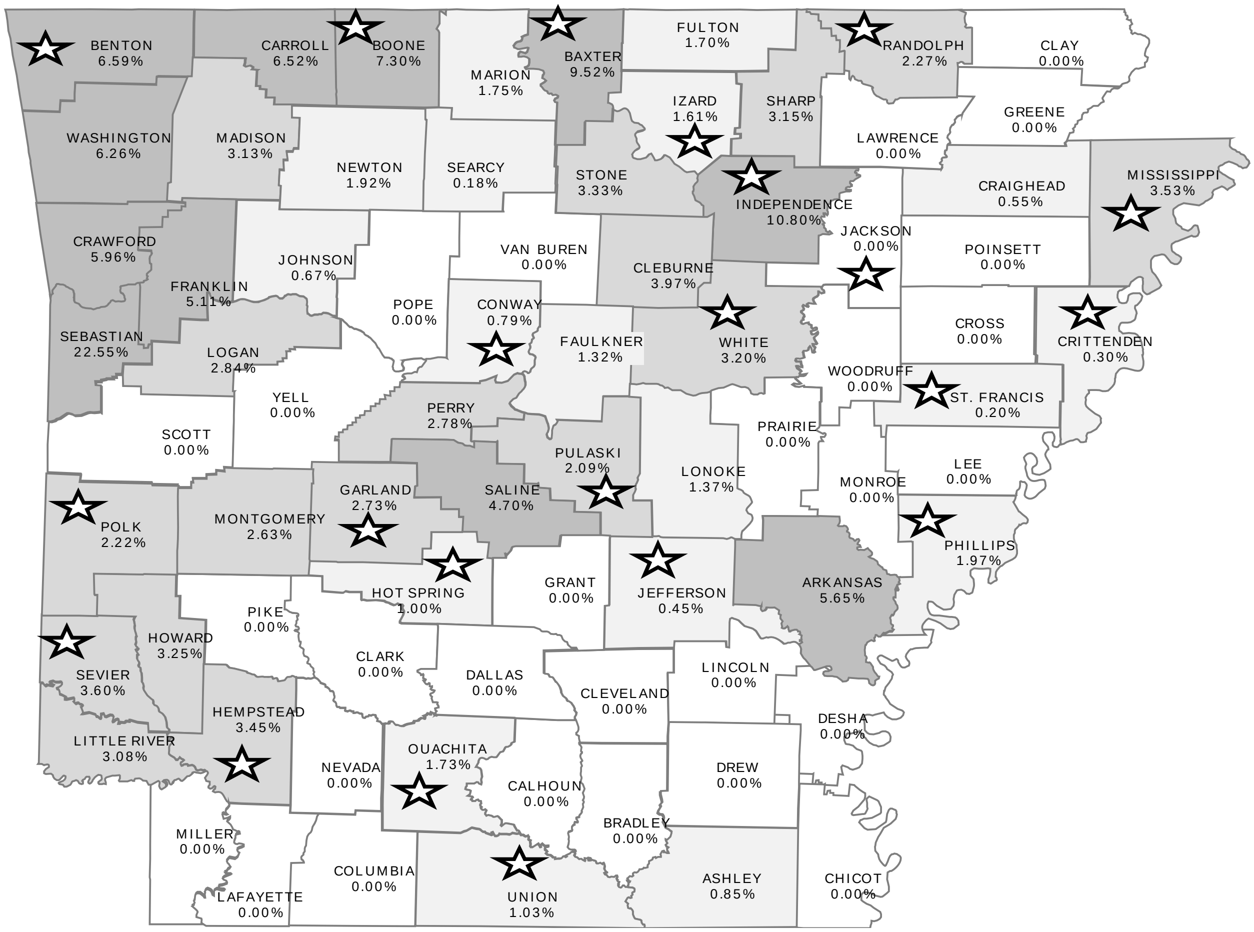

Figure 1. STEM Transfer Participation Rates per Arkansas County and Locations of TYCs. White counties are counties with a 0.00% transfer participation rate. Very light gray indicates transfer participation rates from 0.01 to 2.00%. Light gray counties have transfer participation rates from 2.01 to 3.99%. Finally, dark gray counties have transfer participation rate above 4.00. The counties with a "star" have a two-year college located within the county.

Twenty-nine of the seventy-five Arkansas counties had zero students between 2000 and 2012 transfer into the University of Arkansas and pursue a STEM degree. The majority of those counties are located in southern and western Arkansas where there are large percentages of first-generation students, poverty, and underrepresented minority students. Appendix D includes a list of all Arkansas counties with the transfer participation rate, location of two-year colleges,

presence of an advising center, presence of a transfer center, and the highest mathematics courses offered at each two-year college. Overall, the counties with a two-year college had higher transfer participation rates than counties without a two-year college. In addition, counties with a transfer center appeared to be an indicator of STEM transfer student mobility. Table 10 includes data for each cultural capital variable and whether or not the variable was present within each Arkansas county.

Table 10

Transfer participation rates for select cultural capital variables

Cultural Capital Variables	Two-Year College	Transfer Center	Advising Center
Mean Transfer Participation Rates			
Counties with:	3.02% (22)	4.01% (7)	3.00% (14)
Counties without:	1.79 (53)	2.55 (15)	3.05 (8)

Note. In reviewing each TYC's website, the determination was made if a transfer center and/or an advising center existed on the TYC campus.

In reviewing the two-year college offerings of higher level mathematics courses, Calculus I or higher, counties with a TYC with higher-level mathematics courses did increase the transfer participation rates of students going into a STEM field. Table 11 outlines the different mathematics courses and the transfer participation rates for each.

Table 11

Transfer participation rates for highest mathematics course offered at TYC

Cultural Capital Variables	Below Calculus	Calculus I	Calculus II	Calculus III or above
Mean Transfer Participation Rates				
Counties with:	1.31% (2)	1.26% (2)	2.86% (8)	3.97% (10)

Note. Utilizing each TYC's website and catalog of studies, the highest mathematics course listed in the catalog was determined. It is possible that even though a course is listed in the catalog of studies, the course might not be offered on a regular basis at the TYC.

Research Question Four sought to identify if there were significant differences among select cultural and/or human capital variables. The human capital variables did not reach statistical significance of $p \leq 0.05$. The WLS did find as a county's employment and bachelor degree attainment percentages increase, the STEM transfer participation rates decrease. This seems counterintuitive as the more jobs and bachelor degree residents are in each county, the higher the number of students who would pursue a STEM degree; however, it is possible the students are going straight to a four-year institution instead of beginning at a TYC. The cultural capital variables, did show TYCs need to have a transfer center along with higher-level mathematics courses to increase the number of STEM students pursuing four-year degrees after attending their institution.

Research Question Five.

Research Question Five: What are the policy implications for UA and state leaders related to the findings?

Research Question Five analyzed the transfer policies to determine any policy recommendations that might exist for UA and state of Arkansas policymakers that relate to the findings from Research Questions One through Four. The community capitals framework was used in the study to identify communities which lacked in cultural and/or human capital and the effect the deficiencies have on STEM degree attainment through the two to four-year college transfer path. Acts 672 and 182 aimed to "identify and reduce barriers to enable students to reach the highest attainment level possible….while eliminating obstacles to transfer" with the end goal of increasing retention and graduation of students who transfer (Ar. S. Bill 247, 2005; Ar. H. Bill 1357, 2009).

Acts 672 and 182 would be viewed successful if the three-year graduation rate of TYC students increased, the percent of students transferring to four-year institutions increased, and/or the percent of students still enrolled in college increased. Unfortunately, the success rates, three-year graduation rate plus students still enrolled, of students at Arkansas TYCs decreased between 2009 and 2013, 57.8% to 50.4% (Arkansas Department of Higher Education's Annual Report on Student Retention and Graduation, 2016).

The decrease in success rates of Arkansas' two-year colleges mirrors the results found in Research Question Three for students who transfer into UA STEM degree fields. The three- and five-year graduation rates have both decreased when compared to pre-Act 672's implementation. This shows the end goal of Acts 672 and 182 have yet to be achieved and further research and study throughout Arkansas should occur to determine why students are leaving each TYC. The University of Arkansas needs to perform a comprehensive evaluation as to why transfer students from Arkansas' TYCs are not succeeding and address, using the best practices outlined in the literature review, the poor success rates of these students.

Arkansas' TYCs have a larger percentage of underrepresented minority students than four-year colleges. Yet very few of the UA STEM transfer students were from underrepresented minority backgrounds. The UA should focus transfer recruitment and outreach efforts on students from underrepresented backgrounds to encourage more students to transfer into a STEM field. With a strong job market, higher starting salaries, and a shortage of graduates entering the workforce, underrepresented students would greatly benefit from a STEM degree.

As less transfer students are graduating from UA STEM degrees and TYCs in general, one potential byproduct of Acts 672 and 182 could be students are transferring to four-year institutions earlier than necessary or advisable. Arkansas' overall transfer participation rate is 2.82% compared to 4.01% of Arkansas counties with TYCs which offer a transfer advising center. Arkansas counties with a TYC that do not offer a transfer center have a transfer participation rate below the state's average, 2.55% vs. 2.82%. The cultural capital of having access to transfer resources, advisors, and a clear path toward obtaining a STEM four-year degree appears to be the key factor among the cultural and human capitals studied. Arkansas TYCs without a transfer center need to reevaluate the decision and potentially add one. Through better advising, and encouraging students to stay longer and complete higher level mathematics courses if they are offered, students have a better chance of success upon transferring into a STEM degree.

Chapter Summary

Chapter Four included the data collection methods and analysis used to answer each research questions. After discussing the sources of the data, the next section included how data was analyzed to answer each research question. Research Question One determined the profile of STEM transfer students using descriptive statistics. A comparison of UA STEM transfer student

graduation rates to UA entering STEM freshman graduation rates followed for Research Question Two. Research Question Three aimed to determine if the UA graduation rates of STEM transfer students increased during three periods of time: before Act 672 was implemented; after Act 672 and before Act 182; and finally after Act 182 was implemented. Using WLS regression models, Research Question Four used select human capital variables to determine if the transfer participation rate could be determined by the human capital variables. Cultural capital variables, while not numerical, provided insight into the transfer participation rates for various counties. Research Question Five provided policy implications for policymakers surrounding STEM transfer students.

Chapter V

Conclusions and Discussions

Introduction

Arkansas has a critical need to increase the number of STEM graduates entering the workforce (Arkansas 2025, 2011). Unfortunately, Arkansans are not pursuing STEM degrees in increasing numbers as the state currently ranks last in the percent of STEM degrees conferred compared to overall degrees awarded (National Science Foundation, 2016). This study reviewed the policies in the State of Arkansas and specifically the University of Arkansas aimed at improving the success of students transferring and graduating from four-year institutions to determine the effectiveness of these state policies. With the need to increase the number of STEM graduates in Arkansas, this study focused on STEM students entering the UA from Arkansas TYCs. Arkansas passed Acts 672 and 182 in 2005 and 2009, respectively, to increase the number of students transferring into four-year institutions and decrease the loss of credits transfer students had historically faced. This study analyzed if the UA graduation rates of STEM transfer students increased after each Act was passed. In addition, the graduation rates of STEM transfer students were compared to new STEM freshman at UA. To determine if human and/or cultural capital variables play a factor in determining a student's transfer success, a WLS regression analysis was performed.

Summary of the Study

The US has a critical need to produce more STEM graduates and that need is exponentially more critical in Arkansas. Arkansas currently ranks last in the percent of STEM degrees conferred compared to overall degrees awarded (National Science Foundation, 2016). Students intending to pursue a STEM four-year college degree who start at a two-year college

are significantly less likely to succeed in earning that degree. Arkansas passed Acts 672 and 182, which were aimed at strengthening the success of students who transfer from two-year colleges into four-year institutions. This study sought to evaluate the effectiveness of the Acts by determining if the University of Arkansas has seen an increase in the number of entering STEM transfer students along with an increase in the graduation rates compared to before 2005 when the legislation was passed. Based on the community capitals framework, select cultural and human capital variables for each Arkansas county were analyzed to determine their effect on STEM transfer rates.

A literature review was performed to identify best practices to support STEM transfer students to guide the discussion and recommendations section of this study. In addition, research on how select cultural and human capital variables effect educational attainment was performed. The data for this study came from UA's internal database along with data from the US Census Bureau, Arkansas Department of Higher Education, and the US Bureau of Labor Statistics.

This study used descriptive statistics to identify the profile of the average STEM transfer student. This study found the graduation rate of STEM transfer students decreased after each Act was enacted. Subsequent analysis found a higher percentage of STEM transfer students failed to graduate from the UA, than to entering new freshman. Human capital variables were not a significant predictor of STEM transfer rates for Arkansas counties. Through a Weighted Least Square Regression analysis, select cultural capital variables were indicative of increased STEM transfer rates. Having a two-year college in the county that provided access to transfer centers increased the number of transfer students pursuing STEM degrees. Recommendations for various stakeholders within the two-year colleges, UA and the state of Arkansas were provided to increase STEM participation and transfer success.

Conclusions

This study provided conclusions, listed below, followed by recommendations for various policymakers regarding supporting STEM transfer students and obtaining the STEM workforce Arkansas needs. The conclusions include:

1. Research Question One determined STEM transfer students included a lower percentage of underrepresented minority students than the TYCs they transferred from and lower than the UA's STEM enrollment. Low high school GPA and ACT averages showed many of the students were not academically prepared to begin STEM studies and required remedial courses. Research and subsequent outreach by UA should be performed to determine why underrepresented minority students are not pursuing STEM degrees.
2. Research Question Two found considerable differences between the graduation rates of STEM transfer students when compared to UA new freshman. Close to half of the STEM transfer students were not graduating from the UA with a degree in five-years.
3. Research Question Three showed a drop in three- and five-year graduation rates when compared to before Act 672 was implemented. This finding is concerning as Acts 672 and 182 were aimed at improving the graduation rates of transfer students.
4. Research Question Four included a WLS regression model that found a low percentage of the variability in the STEM transfer participation rate is due to select human capital variables. The model did find that as a county's employment rate and bachelor's degree attainment rates increase, the STEM transfer participation rate does decrease, though the increase is not statistically significantly.

5. Regarding the cultural capital variables, a county having a TYC with a transfer center increases the STEM transfer participation rate along with a county having a TYC within its borders.
6. Research Question Five reviewed the goals of Acts 672 and 182 and it appears the Acts are having an opposite effect to their intended outcomes. The graduation rates of TYCs along with STEM transfer graduation rates at UA have decreased since implementation began in 2005. The implementation of a transfer center at each TYC should be considered by TYC administrators.

Policy Recommendations for University of Arkansas Administration

For University of Arkansas administrators, it should be concerning the three- and five-year graduation rates of transfer students, especially STEM transfer students, are lower than the rate of new freshman. In fall 2016, the UA brought in 4,967 new freshmen and 1,386 new transfer students (Office of Institutional Research Enrollment Report, 2016). Transfer students comprised a considerable percentage, 21.8%, of the UA's fall 2016 incoming class of students yet are not graduating at similar rates.

Underrepresented minority students are disproportionately enrolled in community colleges with 52% of Hispanic students, 44% of African-Americans and 55% of Native Americans (Provasnik & Planty, 2008). Caucasian men have dominated the STEM professions; however, that population alone cannot meet these future labor demands in the US market. Hispanic students make up 5.2% of the college population in Arkansas, but only 0.9% are pursuing degrees in STEM; African-Americans make up 19.1% of the college population, but only 6.8% of the STEM degrees (Complete College America, 2011). This study found

underrepresented minority students comprised 7.1% of UA STEM transfer students versus 12.0% of UA STEM new freshmen.

University of Arkansas administrators could create a point person in each academic college, similar to the recruiters most academic colleges have in participation with UA's Enrollment Services, that focuses on supporting transfer students, working with Arkansas two-year colleges. Academic advising is a critical component of success for transfer students (Hagedorn, Cypers & Lester, 2008). Academic course progression and completion along a transfer path is found to be very important in transfer student success (Hagedorn et al., 2008). Given the majority of Arkansas' TYCs offer at least Calculus I, a person in each academic college encouraging students to continue to enroll in courses and obtain a level of mathematics proficiency prior to transferring into UA might increase STEM transfer success. In the researcher's own experience, students want to transfer to UA as soon as possible; however, when you present a transfer pathway that includes staying at a TYC longer, a student is likely to stay at the TYC and complete the gateway mathematics courses required for the majority of STEM degrees.

One issue University of Arkansas administrators could consider is identifying the "gateway" courses within a STEM degree that might not traditionally be offered at smaller TYCs and putting those courses online for TYC students to take. For example, several engineering degree programs have a six-semester sequence of courses that must be taken in order. If the first or second course in the sequence was offered online through UA's Global Campus, it could shorten the time to degree completion for transfer students. It would also be a source of additional revenue for UA through increased tuition.

Policy Recommendations for Two-Year College Administrators

Arkansas reflects the national picture of TYCs enrolling large percentages of underrepresented minority, first-generation, financially-needy students. For many Arkansas students, TYCs are the only economically feasible option for higher education. Poverty is widespread in Arkansas (99% of K-12 students in the Arkansas Delta region, for example, receive free or reduced lunches) and TYCs offer a cost-effective way for Arkansas' economically-disadvantaged students to complete their prerequisite coursework before transferring to a university (State Education Data Center, 2006). Of the 120,545 students attending Arkansas' 22 TYCs in 2014, only 2,657 (2.2%) are enrolled in STEM degree programs (Annual Enrollment Report, 2015). This study has shown that few TYC students continue on to a four-year STEM degree at UA.

In analyzing the human capitals for each Arkansas county, this study found no statistically significant predictors of increasing STEM transfer students based on variables such as bachelor degree attainment, poverty rate, median household income, or employment rate. Future research might expand the analysis to include all 4-year public universities and an analysis to determine whether or not students are transferring into local institutions with STEM degrees instead of UA. For TYC administrators, the findings from the cultural capital variables warrant further consideration for their institution. The creation of transfer centers, in addition to offering higher-level mathematics courses, encourages STEM students to transfer into a four-year STEM degree. The transfer centers provide the institutional agents that provide information, self-efficacy, and positive interactions with STEM faculty and staff. All are important when considering one's cultural capital (Starobin, Smith, & Laanan, 2016).

A final consideration for TYC administrators could be strengthening their concurrent enrollment with local K-12 school districts. Integrating students into their STEM pathways, encouraging students to take lower-level mathematics courses like College Algebra in high school provides a good foundation for the higher-level mathematics and science courses at the TYC and shortens the time to graduation for students. It also provides a revenue stream for the two-year colleges.

Policy Recommendations for Policymakers Within State of Arkansas

In reviewing Figure 1, *STEM Transfer Participation Rates per Arkansas County and Locations of TYCs*, it is obvious parts of Arkansas are lacking when it comes to STEM degree attainment, especially those counties without a two-year college located within its borders. Given the lack of a qualified STEM workforce within Arkansas, state policy makers could consider how to encourage students to pursue STEM degrees by utilizing scholarship funding. The Arkansas Academic Challenge, also known as the "lottery scholarship", currently does not encourage students to go into a high-demand field of study. Pittman (2014) found no significant gains in college participation for underrepresented students or underserved counties after the "lottery scholarship" was instituted, even though significant increases in college participation occurred for more affluent counties. Providing financial incentives should be tied to cultural capital variables of increased institutional agents at the TYCs, local K-12 schools, and four-year institutions. The Arkansas counties with those institutional agents currently have a higher success rate of students transferring into STEM degrees.

The creation of those institutional agents at each two-year college would be an important first step for Arkansas policy makers to take. A statewide conference each year between the transfer center staff and faculty and staff from the four-year institutions in Arkansas would help

facilitate the flow of knowledge between institutions. If high school counselors were to attend, a strong K-20 partnership could be formed for each county in Arkansas.

Recommendation for Future Research

Further research could be performed to determine why students at each two-year college are not graduating from STEM associate degree programs and/or transferring into four-year UA STEM degree programs. The current study only looked into the human and cultural capitals along with the STEM transfer rate into UA. Through the implementation of transfer centers, and other institutional agents who are there to support transfer students, an important first step would be to perform an internal analysis and learn why students are not graduating or successfully transferring, especially for STEM fields that are in such high-demand. Focus groups at each two-year college might provide insight into why students are either not completing a STEM associate’s degree or successfully transferring into a four-year STEM degree.

For UA administrators, future research could include performing focus groups on students that transferred from an Arkansas two-year college into a UA STEM field to determine the challenges and roadblocks for transfer students. The focus groups could be divided into four distinct groups: 1) students who transferred into UA within the past year; 2) students who are close to graduating with a UA degree; 3) students who departed UA without earning a degree; and 4) UA alumni that successfully transferred from an Arkansas TYC and graduated with a UA STEM degree. This study focused only on the quantitative data behind STEM transfer students. The focus groups would either compliment or contradict the findings of this study, thus providing deeper analysis and results for UA administrators to consider when making changes to support transfer students.

Additional research could include different human and/or cultural capital variables to determine if there are other significant predictors for a county to review when trying to increase the number of STEM transfer students. This study also only focused on two of the seven community capitals. Further analysis could be performed on social capital, in particular, that might provide insight for researchers.

Discussions

If Arkansas' STEM talent pool does not grow, the unmet demand for talented young scientists and engineers may lead employers to move their technology centers out of Arkansas, leaving the state further behind economically than the state currently is (Arkansas STEM Works, 2012). With the implementation of two state laws over the past decade aimed at increasing the success of transfer students, Arkansas has attempted to address the underlying issues. Arkansas has a critical need for more STEM graduates to fill the jobs the majority of Arkansans are not qualified to fill as only 26% of Arkansans have the minimally required associate's degree or higher (Complete College America, 2011).

Although the number of high school students entering the UA to pursue a STEM degree has increased over the past few years, transfer students are a pool of potential majors that should be expanded. Nearly half, or 44%, of students earning a baccalaureate engineering degree attended a community college at some time during their academic career (National Science Foundation, 2014). The UA is one of the most expensive four-year public institutions in Arkansas and students often need to attend another institution and transfer to UA to limit expenses. First generation and minority students are often more likely to attend a local institution before transferring to UA (National Academy of Sciences, 2011). To bridge the gap

of STEM educational attainment, transfer students need to graduate in a reasonable time following their transfer.

The recruitment of underrepresented groups into the STEM fields is essential to the future of the profession and the country, meeting current labor demands while protecting the US economic future. Caucasian men have dominated the STEM professions; however, that population alone cannot meet these future labor demands in the US market. Hispanic students make up 5.2% of the college population in Arkansas, but only 0.9% are pursuing degrees in STEM; African-Americans make up 19.1% of the college population, but only 6.8% of the STEM degrees (Complete College America, 2011).

Through the Community Capital Framework (CCF) and measuring the applicable seven community capitals, this study was designed to determine if underlying cultural and human capital constraints are inherently affecting STEM educational attainment of students who start at Arkansas two-year colleges with the intent on transferring to a four-year institution.

Previous studies have looked at a student's intent to transfer into a STEM field and identified several cultural capital factors such as parental education levels, family encouragement and access to institutional agents (Kruse, 2013; Jorstad, 2015). Interactions with institutional agents, academic advisors and counselors, as well as enrollment in previous math courses, are strong predictors of intention to transfer and pursue a STEM degree (Jorstad, 2015). These previous studies have focused on a student's intent to transfer to a four-year institution and pursue a STEM degree. However, this study includes select cultural and human capital variables of STEM students who actually transfer to a four-year institution. By reviewing the cultural capital STEM students receive, or inherit, from their two-year college community, local communities and families, in addition to how race, gender, ethnicity and first-generation status

affect cultural capital, this study will identify variables that determine success for STEM transfer students. Given Arkansas is a rural state with large portions of the population below the poverty line, first generation and/or ethnic minority, this study used select human and cultural capital variables to determine the likelihood a student would successfully transfer from a two-year college into UA and complete a STEM degree.

This study came to several conclusions policymakers should consider to improve the number and success of STEM transfer students. First, the number of underrepresented minority students pursuing UA STEM degrees who transfer from TYCs in Arkansas are disproportionally low compared to the TYC enrollment. Outreach by UA offices should occur to encourage underrepresented students to pursue STEM degrees. The low graduation rates of STEM transfer students, at both three- and five-years, is compared to that of new freshman is a concern given the number of hours the STEM students bring into the UA. With close to half of the STEM transfer students not graduating with a UA degree in five-years should encourage UA administrators to review the best practices to support STEM transfer students, identified in this study, and develop programs incorporating those practices. The decrease in the three- and five-year graduation rates for STEM transfer students after the implementation of Acts 672 and 182 should prompt a review of the Acts at the state-level to determine if the same is occurring at other four-year institutions in Arkansas. Finally, TYC administrators and state policymakers should consider establishing a transfer center at each TYC location to encourage students to complete the right courses for STEM degrees and transfer at the appropriate time. A close collaboration between the transfer centers and the four-year institutions is necessary for maximum effectiveness.

Chapter Summary

Chapter Five summarized the conclusions from this study into six recommendations for policy makers to consider. Further recommendations were made to three constituent groups: University of Arkansas administrators; two-year college administrators; and policy makers within the state of Arkansas. Future research included the recommendation of performing a qualitative study to strengthen or determine alternative findings for this study. Focus groups of students at two-year colleges in addition to students that have already transferred to UA STEM degrees will provide additional data for policy makers to consider.

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Appendices

Appendix A

Transfer Participation Rate

Table 12

Dependent Variable: Transfer Participation Rate per Arkansas county

County	High School Graduates	Full-Time College Enrollment	STEM Transfer Students	Transfer Participation Rate
Arkansas	210	124	7	5.645%
Ashley	231	118	1	0.847
Baxter	326	168	16	9.524
Benton	2,367	1,061	70	6.598
Boone	408	233	17	7.296
Bradley	134	55	0	0.000
Calhoun	45	23	0	0.000
Carroll	227	92	6	6.522
Chicot	109	44	0	0.000
Clark	186	118	0	0.000
Clay	172	69	0	0.000
Cleburne	227	126	5	3.968
Cleveland	101	57	0	0.000
Columbia	249	137	0	0.000
Conway	214	126	1	0.794
Craighead	998	542	3	0.554
Crawford	748	386	23	5.959
Crittenden	654	334	1	0.299

Table 12 (continued)

County	High School Graduates	Full-Time College Enrollment	STEM Transfer Students	Transfer Participation Rate
Cross	250	119	0	0.000%
Dallas	76	36	0	0.000
Desha	174	91	0	0.000
Drew	210	99	0	0.000
Faulkner	1,117	684	9	1.316
Franklin	232	137	7	5.109
Fulton	127	59	1	1.695
Garland	893	513	14	2.729
Grant	294	155	0	0.000
Greene	425	227	0	0.000
Hempstead	227	116	4	3.448
Hot Spring	353	199	2	1.005
Howard	206	123	4	3.252
Independence	361	213	23	10.798
Izard	118	62	1	1.613
Jackson	142	74	0	0.000
Jefferson	775	444	2	0.450
Johnson	254	149	1	0.671
Lafayette	70	34	0	0.000

Table 12 (continued)

County	High School Graduates	Full-Time College Enrollment	STEM Transfer Students	Transfer Participation Rate
Lawrence	218	106	0	0.000%
Lee	70	40	0	0.000
Lincoln	108	51	0	0.000
Little River	132	65	2	3.077
Logan	253	141	4	2.837
Lonoke	862	439	6	1.367
Madison	155	64	2	3.125
Marion	124	57	1	1.754
Miller	377	114	0	0.000
Mississippi	506	255	9	3.529
Monroe	87	42	0	0.000
Montgomery	70	38	1	2.632
Nevada	102	64	0	0.000
Newton	94	52	1	1.923
Ouachita	313	173	3	1.734
Perry	128	72	2	2.778
Phillips	254	152	3	1.974
Pike	142	75	0	0.000
Poinsett	269	130	0	0.000

Table 12 (continued)

County	High School Graduates	Full-Time College Enrollment	STEM Transfer Students	Transfer Participation Rate
Polk	250	135	3	2.222%
Pope	637	363	0	0.000
Prairie	88	45	0	0.000
Pulaski	2,902	1,580	33	2.089
Randolph	160	88	2	2.273
Saint Francis	864	509	1	0.196
Saline	253	149	7	4.698
Scott	103	52	0	0.000
Searcy	1,089	550	1	0.182
Sebastian	381	204	46	22.549
Sevier	193	111	4	3.604
Sharp	266	127	4	3.150
Stone	104	60	2	3.333
Union	519	292	3	1.027
Van Buren	154	78	0	0.000
Washington	2,342	1,023	63	6.158

Table 12 (continued)

County	High School Graduates	Full-Time College Enrollment	STEM Transfer Students	Transfer Participation Rate
White	790	406	13	3.202%
Woodruff	75	36	0	0.000
Yell	268	131	0	0.000

Appendix B

College-Going Rate per Arkansas county

Table 13

College-Going Rate per Arkansas county

County	College-going rate
Arkansas	58.30%
Ashley	50.90
Baxter	46.70
Benton	47.80
Boone	55.60
Bradley	48.10
Calhoun	47.50
Carroll	46.60
Chicot	37.10
Clark	67.80
Clay	47.80
Cleburne	48.40
Cleveland	56.20
Columbia	52.20
Conway	53.40
Craighead	55.90
Crawford	50.70
Crittenden	43.30

Table 13 (continued)

County	College-going rate
Cross	42.50%
Dallas	39.80
Desha	50.00
Drew	48.30
Faulkner	61.30
Franklin	57.10
Fulton	44.60
Garland	59.30
Grant	49.70
Greene	52.80
Hempstead	55.30
Hot Spring	58.20
Howard	62.90
Independence	58.60
Izard	51.60
Jackson	58.20
Jefferson	53.10
Johnson	49.20
Lafayette	59.50

Table 13 (continued)

County	College-going rate
Lawrence	49.30%
Lee	51.70
Lincoln	46.20
Little River	49.30
Logan	58.00
Lonoke	46.30
Madison	40.40
Marion	40.20
Miller	36.00
Mississippi	48.00
Monroe	46.30
Montgomery	47.30
Nevada	67.00
Newton	51.00
Ouachita	57.50
Perry	57.50
Phillips	50.90
Pike	52.80

Table 13 (continued)

County	College-going rate
Poinsett	51.00%
Polk	53.20
Pope	57.10
Prairie	46.00
Pulaski	45.70
Randolph	47.90
Saint Francis	58.60
Saline	48.40
Scott	48.20
Searcy	47.80
Sebastian	54.10
Sevier	62.30
Sharp	44.80
Stone	56.00
Union	51.30
Van Buren	50.00
Washington	42.00

Table 13 (continued)

County	College-going rate
White	42.90%
Woodruff	44.70
Yell	45.20

Appendix C

Human Capital Variables per Arkansas county

Table 14

Human Capital Variables per Arkansas county

County	Employment Rate	Median Household Income	Bachelor Degree Attainment	Poverty Rate
Arkansas	4.4	$39,633	12.4	15.8
Ashley	8	$35,683	12.2	18.9
Baxter	5.7	$35,343	16.5	15.5
Benton	3.9	$54,515	28.7	12.2
Boone	5.1	$38,506	15.4	16.6
Bradley	6.2	$30,409	10.8	31.3
Calhoun	5.8	$30,980	7.4	14.9
Carroll	4.8	$36,584	17.3	18.8
Chicot	9.4	$26,201	12.6	33
Clark	5.7	$32,721	21.4	24.3
Clay	6.9	$31,502	9.5	20.2
Cleburne	7.2	$40,246	16.8	15.8
Cleveland	5.8	$39,420	13.8	17.7
Columbia	6.8	$35,128	20.3	25.4
Conway	6.3	$35,225	14.7	24
Craighead	4.6	$41,393	24.4	20.6
Crawford	5.4	$39,479	14.3	20.2
Crittenden	6.4	$37,751	13.9	26.3

Table 14 (continued)

County	Employment Rate	Median Household Income	Bachelor Degree Attainment	Poverty Rate
Cross	5.6	$38,085	11.4	17.4
Dallas	7.4	$28,931	10.2	19.7
Desha	7.6	$28,680	12.7	30.1
Drew	7.1	$31,171	19.1	28.5
Faulkner	4.8	$50,314	27.2	14.6
Franklin	5.2	$36,766	12.4	20.5
Fulton	5.4	$35,522	10	18.7
Garland	5.7	$39,162	20.9	20.7
Grant	4.7	$49,004	17.6	9.9
Greene	5.3	$38,413	14.7	17.1
Hempstead	5.2	$32,056	14.1	27.4
Hot Spring	5.2	$41,193	12.3	14.2
Howard	4.4	$35,879	12	23.2
Independence	6.7	$35,026	14.4	23.7
Izard	6.9	$30,661	11.7	18.7
Jackson	7.8	$30,284	8.8	28.4
Jefferson	7.2	$37,140	17.5	23.9
Johnson	6.0	$31,003	14.7	20.1

Table 14 (continued)

County	Employment Rate	Median Household Income	Bachelor Degree Attainment	Poverty Rate
Lafayette	7.9	$29,732	10.7	24.1
Lawrence	6.3	$32,239	10.4	25.4
Lee	6.9	$25,034	7.1	31.5
Lincoln	6.3	$32,697	7.9	27
Little River	5.7	$39,673	10.6	14
Logan	5.9	$34,996	11.7	17.6
Lonoke	4.3	$52,582	18.2	13.2
Madison	3.9	$35,771	10.3	22.6
Marion	5.4	$34,494	12.9	18.9
Miller	5.2	$41,319	13.9	19.5
Mississippi	9.3	$36,428	13	24.9
Monroe	6.3	$27,263	11.3	28.8
Montgomery	7.0	$31,345	12.9	22.0
Nevada	5.2	$33,694	12.8	26.5
Newton	5.1	$30,038	12.7	23.5
Ouachita	6.6	$32,015	15.5	23.1
Perry	6.3	$42,455	11.9	15.6
Phillips	7.9	$26,737	12	33.5

Table 14 (continued)

County	Employment Rate	Median Household Income	Bachelor Degree Attainment	Poverty Rate
Pike	6.2	$32,206	13.8	24.8
Poinsett	5.7	$32,089	8.6	28.1
Polk	6.0	$32,835	12.3	23.1
Pope	5.5	$40,453	20.7	19.3
Prairie	4.8	$34,855	9.3	21.2
Pulaski	4.7	$46,013	31.2	17.2
Randolph	7.4	$34,418	12.3	21.8
Saint Francis	7.5	$55,348	23.4	8.6
Saline	4.2	$37,448	11.6	20.0
Scott	5.0	$30,779	12.0	26.1
Searcy	5.8	$40,471	19.2	21.2
Sebastian	5.0	$35,153	8.6	24.4
Sevier	6.4	$30,861	11.0	23.9
Sharp	7.1	$30,873	11.7	28.4
Stone	6.5	$29,832	14.2	25.5
Union	6.4	$37,435	16.1	21.5
Van Buren	7.0	$32,517	13.6	24.5
Washington	3.6	$41,248	28.7	20.7

Table 14 (continued)

County	Employment Rate	Median Household Income	Bachelor Degree Attainment	Poverty Rate
White	6.5	$42,487	18.1	17.5
Woodruff	6.7	$28,259	10.1	24.3
Yell	5.3	$35,535	9.4	22.7

Appendix D

Select Cultural Capital Variables

Table 15

Select Cultural Capital Variables per Arkansas county

County	Transfer Participation Rate	TYC Within County	TYC Advising Center	TYC Transfer Center	TYC Highest Math Course
Arkansas	5.645%				
Ashley	0.847				
Baxter	9.524	Yes	No	No	Calculus II
Benton	6.598	Yes	Yes	Yes	Diff. Eq
Boone	7.296	Yes	Yes	No	Calculus III
Bradley	0.000				
Calhoun	0.000				
Carroll	6.522				
Chicot	0.000				
Clark	0.000				
Clay	0.000				
Cleburne	3.968				
Cleveland	0.000				
Columbia	0.000				
Conway	0.794	Yes	Yes	No	Calculus I
Craighead	0.554				
Crawford	5.959				
Crittenden	0.299	Yes	Yes	No	Calculus II

Table 15 (continued)

County	Transfer Participation Rate	TYC Within County	TYC Advising Center	TYC Transfer Center	TYC Highest Math Course
Cross	0.000%				
Dallas	0.000				
Desha	0.000				
Drew	0.000				
Faulkner	1.316				
Franklin	5.109				
Fulton	1.695				
Garland	2.729	Yes	Yes	Yes	Diff. Eq.
Grant	0.000				
Greene	0.000				
Hempstead	3.448	Yes	No	No	Calculus II
Hot Spring	1.005	Yes	No	No	Trigonometry
Howard	3.252				
Independence	10.798	Yes	Yes	Yes	Calculus III
Izard	1.613	Yes	No	No	PreCalculus
Jackson	0.000	Yes	Yes	No	Calculus III
Jefferson	0.450	Yes	Yes	No	Calculus II
Johnson	0.671				
Lafayette	0.000				

Table 15 (continued)

County	Transfer Participation Rate	TYC Within County	TYC Advising Center	TYC Transfer Center	TYC Highest Math Course
Lawrence	0.000%				
Lee	0.000				
Lincoln	0.000				
Little River	3.077				
Logan	2.837				
Lonoke	1.367				
Madison	3.125				
Marion	1.754				
Miller	0.000				
Mississippi	3.529	Yes	Yes	Yes	Diff. Eq.
Monroe	0.000				
Montgomery	2.632				
Nevada	0.000				
Newton	1.923				
Ouachita	1.734	Yes	Yes	No	Calculus I
Perry	2.778				
Phillips	1.974	Yes	No	No	Calculus III
Pike	0.000				
Poinsett	0.000				

Table 15 (continued)

County	Transfer Participation Rate	TYC Within County	TYC Advising Center	TYC Transfer Center	TYC Highest Math Course
Polk	2.222%	Yes	No	No	Calculus II
Pope	0.000				
Prairie	0.000				
Pulaski	2.089	Yes	Yes	No	Calculus III
Randolph	2.273	Yes	Yes	No	Calculus II
Saint Francis	0.196	Yes	Yes	Yes	Calculus III
Saline	4.698				
Scott	0.000				
Searcy	0.182				
Sebastian	22.549				
Sevier	3.604	Yes	No	No	Calculus II
Sharp	3.150				
Stone	3.333				
Union	1.027	Yes	No	Yes	Calculus II
Van Buren	0.000				
Washington	6.158				

Table 15 (continued)

County	Transfer Participation Rate	TYC Within County	TYC Advising Center	TYC Transfer Center	TYC Highest Math Course
White	3.202%	Yes	Yes	Yes	Calculus III
Woodruff	0.000				
Yell	0.000				

Appendix E

Institutional Review Board Approval Letter

February 23, 2017

MEMORANDUM

TO: Bryan HIll
Michael Miller

FROM: Ro Windwalker
IRB Coordinator

RE: New Protocol Approval

IRB Protocol #: 17-02-440

Protocol Title: *Evaluating the Policies that Lead to STEM Educational Attainment at the University of Arkansas for Transfer Students*

Review Type: ☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB

Approved Project Period: Start Date: 02/20/2017 Expiration Date: 02/19/2018

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (https://vpred.uark.edu/units/rscp/index.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 4,500 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 109 MLKG Building, 5-2208, or irb@uark.edu.