

# Cultivating Cohesion: Nurturing Knowledge and Collaboration in the Norman Borlaug Youth in Agriculture Program

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## Abstract

*The evolving face of agriculture presents unique problems that today's youth will be charged with solving as they enter the workforce. Thus, it is imperative that youth not only have a deep understanding of the processes and systems that have an influence on the food and fiber industry, but also possess the skills to effectively collaborate with their peers (Hess & Trexler, 2011). The Norman Borlaug Youth in Agriculture Program (NBYAP) aimed to immerse urban and rural youth in problem-based learning curriculum to inspire participants from unique backgrounds to collaborate to solve complex challenges facing Texas agriculture. By distributing Qualtrics surveys, participants' agricultural knowledge and cross-group perceptions were measured during the three different phases of the program. To assess the mean differences between each phase of the program, a repeated measure MANOVA was employed for the seven constructs of agricultural knowledge and the rural-urban connection. The findings from this study indicate the effectiveness of problem-based learning (PBL) curriculum to elicit change in participants' intergroup perceptions along with increased agricultural knowledge. The study highlights the importance for Extension personnel and agricultural educators to develop programs that encourage youth to creatively solve 21st century agricultural problems while concurrently providing an environment that youth can develop positive relationships across diverse groups.*

## Introduction

Adolescence is a developmental period denoted by youth discovering their identity, exploring their individuality, and learning about potential adult roles (Dickey et al., 2020). This developmental phase is crucial for youth to acquire essential 21st century skills that will be beneficial to their well-being and career success as they transition into adulthood (Nasheeda et al., 2019; Sawyer et al., 2018). To be competitive when entering the workforce, adolescents will need to have analytical thinking skills, the ability to actively learn, and the capacity to effectively solve complex problems through collaborations (Li, 2022; Rios et al., 2020). Further, this developmental period is pivotal for the maturation of vital competencies for establishing cross-group relationships (Watkins et al. 2007).

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Fostering cross-group cohesion among adolescents is imperative for preparing youth to transition into adulthood where interacting with diverse groups is becoming the standard (Laurence, 2020). Since an individual's bias against groups heterogeneous to oneself begin to emerge during childhood then continue to develop into adolescence, it is essential for youth to be involved in programs and interventions that aim to promote healthy peer interaction (Aboud et al., 2012; Grapin et al., 2019; Tropp et al., 2022). Interventions that focus on intergroup contact, face-to-face connections among youth of different social groups, assist in alleviating prejudice as well as elicit positive intergroup attitudes (Tropp et al., 2022). In addition to face-to-face interactions, researchers have found that providing youth with *E-contact*, the process of utilizing internet-based communication tools amongst diverse groups, to be effective in establishing social harmony (White et al., 2020). The effectiveness of E-contact relies on the communication being centered around a common goal that pertains to both groups' interests (White et al., 2020). Environments that span beyond the confines of traditional, structured education tend to provide youth with programming that is more supportive in generating positive interactions amongst diverse groups (Laurence, 2019; Laurence, 2020).

An out-of-school time (OST) program is defined as any youth programming that is attended when school is not in session (Centers for Disease Control and Prevention, 2022). National 4-H, a well-established OST program, is the most prominent youth development organization as it serves over six million young people every year (National 4-H Council, 2023). Historically, youth participation in 4-H activities has been linked to learning interpersonal competencies such as teamwork, leadership, communication, and social skills (Durlak et al., 2010; Hansen et al., 2019; Larson et al., 2005). Through an agricultural setting, the 4-H program was founded on delivering curriculum with experiential learning principles. Thus, providing youth with an opportunity to develop and apply learned concepts to real world situations (Borden et al., 2014).

Agricultural education-based programs aim to enrich youth participants through improving their agricultural knowledge, increase awareness of local problems, invoke social activism, and incorporate various elements of positive youth development such as leadership and teamwork skills (Delia & Krasny, 2018; Rogers et al., 2020; Russ & Gaus, 2021). By providing youth with a deeper understanding of social justice issues, agriculture education programs have the ability to ignite youths' appreciation and respect for civic engagement (Russ & Gaus, 2021). Further, agriculturally based programs facilitate the development of agricultural literacy in youth (Bradford et al., 2019; Pinkerton et al., 2021; Powell et al., 2008). Youth who are agriculturally literate are empowered to make informed decisions regarding their food choices, critically evaluate agriculture information, and effectively form opinions on agricultural practices and policy (Spielmaker & Leising, 2013).

### Conceptual Framework

Problem-based learning (PBL) was originally founded as a teaching strategy for the medical field as it centers learning around solving real-world problems. PBL utilizes a constructivist approach to the transfer of knowledge from facilitator to student (Jonassen, 1997; Burriss and Garton, 2007). The foundational aim of PBL is for learners to actively collaborate with peers while developing critical thinking skills and strategies (Dochy et al. 2003; Yew and Goh, 2016). Many secondary educators have implemented the PBL framework into classrooms to enhance students' knowledge acquisition and skill development (Lonergan et al. 2022; Wilder, 2015).

A defining characteristic of PBL is the students' active inquiry towards defined goals. The PBL objectives can be outlined as: (a) actively forming new knowledge, (b) solving relevant problems, (c) developing self-directed learning competencies, and (d) initiating effective collaborations (Chen & Hong, 2016; Lonergan et al. 2022). There are four key elements to implementing PBL into curricula. The first involves embracing a non-linear direction of learning by allowing students to explore various ideas,

directions, and theories to the problem (Barrows, 1986; Davidson & Major, 2014). The second component entails incorporating authentic problems that are not only current, real-world problems, but also culturally relevant to the students (Barrows, 1986). The third element requires teachers to function as facilitators whose purpose is to provide guidance and resources (Davidson & Major, 2014). Lastly, the fourth construct involves ensuring that the PBL curricula is individualized by connecting students' learning styles to the activities as well as allowing students to have sufficient room for creativity (Ghani et al. 2021).

### **Purpose**

The Norman Borlaug Youth in Agriculture Program (NBYAP) served as a connection point for youth to learn about agricultural conservation, cross-group understanding, and advocacy education. The purpose of this study was to evaluate the effectiveness of the pilot of the NBYAP. Specifically, the research team aimed to address the following questions:

1. Does participation in the NBYAP's PBL curricula elicit a positive change in youths' agricultural knowledge in the realm of agricultural impact, biotechnology, livestock reproduction and nutrition, methane and wheat production, and the poultry industry?
2. What impact does the participation in the PBL curricula in the NBYAP have on youths' cross-group perceptions?

### **Methodology**

#### **Study Context**

The NBYAP, the setting for this study, is an academic enrichment program developed for outstanding high school students from around Texas. Over the course of six months, youth participated in the three-phases of the program. Each phase, Planting Season, Growing Season, and Harvesting Season were three-day, in-person sessions that incorporated a variety of PBL activities. During the Planting Season, participants were engaged in an array of agricultural-based activities that covered topics from livestock reproductive techniques to understanding the methane issues that impact the industry. Further, youth participated in team building exercises that encouraged youth to start building cross-group (rural versus urban) relationships through collaboration. The second phase, Growing Season, was focused on youth being divided into teams that had an equal representation of rural and urban youth. Within the teams, youth were provided with a 21st century issue that is combated by the agricultural industry. The youth were encouraged to brainstorm solutions within their teams. In the last phase, Harvesting Season, youth presented their capstone team projects. The capstone project entailed youth collaborating with their peers to devise a strategic plan to abate their assigned agricultural industry problem.

To establish the E-contact amongst youth, the participants were required to participate in weekly virtual professional and personal development sessions between each in-person phase. During these sessions, youth were given the opportunity to develop invaluable civic, social and leadership skills.

#### **Participants**

The participants were 35 high school youth from across Texas that were admitted to the NBYAP program through an application process. The percentage of rural and urban youth was balanced, 51.4% and 48.6%, respectively. To be considered for the program, youth had to be: (a) a Texas resident, (b) a high school student which was defined as being in 9<sup>th</sup>-12<sup>th</sup> grade, (c) in good academic standing, and (d) able to attend each in-person phase of the program. For rural youth to be considered, they had to be in an active 4-H leadership role which included being a Texas 4-H State Council or being a Texas 4-H Livestock, Equine or Poultry Ambassador. Further, rural youth had to reside in a town with a population of 50,000 or less. The urban youth had to reside within Harris County and be a member of FFA. The demographic background of the entire youth sample is outlined in Table 1.

**Table 1***Demographic Characteristics of NBYAP Participants*

Characteristic	<i>f</i>	%
Age		
15	2	5.7
16	8	22.9
17	14	40
18	11	31.4
Gender		
Female	26	74.3
Male	9	25.7
Race/Ethnicity		
African American or Black	7	20
Asian	2	5.7
Caucasian or White	17	48.6
Hispanic or Latino	9	25.7
Residency		
Rural	18	51.4
Urban	17	48.6

*Note.*  $N = 35$ . The reported age is derived from the first data collection at the commencement of the program.

**Instrumentation**

A group of extension personnel and youth development researchers developed the instrument constructs. All variables were self-reported on a 7-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *somewhat disagree*, 4 = *neither agree nor disagree*, 5 = *somewhat agree*, 6 = *agree*, 7 = *strongly agree*). Participants with a higher mean score signified a greater level of perceived agricultural knowledge along with a higher level of appreciation for the rural-urban connection. Cronbach's Alpha was evaluated to determine the reliability of each construct. Agricultural knowledge encompassed seven different dimensions of agriculture: wheat production ( $\alpha$  ranges from .716 to .937), biotechnology ( $\alpha$  ranges from .730 to .887), livestock nutrition ( $\alpha$  ranges from .825 to .860), livestock reproduction ( $\alpha$  ranges from .520 to .883), methane production ( $\alpha$  ranges from .789 to .952), poultry industry ( $\alpha$  ranges from .90 to .915), and impact of the agricultural industry ( $\alpha$  ranges from .435 to .831). Each agricultural knowledge construct was developed to address the content of the program curriculum. To understand the cross-group perceptions among the participants, the rural-urban connection construct was developed. The rural-urban connection construct consisted of five different items addressing beliefs about the interactions of rural and urban

communities and agriculturists ( $\alpha$  ranges from .640 to .720). For example, youth were asked to self-rate their opinion on the statement, 'rural agriculturists could benefit from positive relationships with urban community leaders.' To gain a deeper understanding of youths' cross-groups perceptions, open-ended questions were incorporated into the Qualtrics. Youths' demographic data was gathered through four questions that addressed the participants' age, gender, race and ethnicity, and residency (rural versus urban).

### Data Collection and Analysis

To examine whether the NBYAP program elicited change in participants' agricultural knowledge as well as their perceived rural-urban connection, Qualtrics surveys were distributed during the three phases of the NBYAP program. All participants responded to all questionnaires across the three data collection time points, except for one missing response for the last collection of the rural-urban connection. The first wave of data collection of agricultural knowledge and rural-urban connection occurred before the Planting Season, and the second wave of data collection was conducted directly after the conclusion of the Planting Season. The third assessment of agricultural knowledge was done before the Harvesting Season, and the third assessment of rural-urban connection was conducted after the Harvesting Season.

The current study analyzed data using SPSS version 26 (IBM Corp, 2019). A repeated measure multivariate analysis of variance (MANOVA) was used to examine mean-level differences among the three different time points of data collection. Since MANOVA tests are susceptible to data outliers, the normal distribution of the data was evaluated for skewness, kurtosis, and the Shapiro-Wilk test (Olejnik, 2010). Partial  $\eta^2$  was evaluated to determine the effect size for each dependent variable. According to Cohen (1988), partial  $\eta^2$  values can be explained as .01 indicating a small effect, .06 a medium effect, and .14 as a large effect. Bonferroni multiple comparison tests were employed to determine specific differences between each time of data collection.

### Qualitative Analysis

A qualitative analysis was conducted of the open-ended questions to capture the detailed perceptions that youth had toward their peers from different regions. Researchers must recognize the potential of personal bias when interpreting qualitative data (Creswell, 2007). The researchers included a current doctoral student in the Agricultural Leadership, Education, and Communications department at an 1862 land-grant university with a background in Extension education along with a doctoral student in the Educational Psychology department that has a research focus in cultural competence and positive youth development. Through the researchers' personal and professional lenses, the participant responses to open-ended questions were analyzed. To unearth any emerging themes within the youth responses, a thematic analysis was utilized to interpret and categorize participants' responses. This qualitative analysis involves condensing the data into representative themes that accurately capture the meaning of each participants' answer (Krippendorff, 2018).

## Results

### Quantitative Results

Research question one aimed to examine whether the NBYAP had the ability to improve participants' agricultural knowledge across seven different dimensions. Time exerted a significant linear and quadratic effects on wheat production ( $F(1,34) = 51.503, p < .001$ , partial  $\eta^2 = .602$ , observed power = 1.000;  $F(1,34) = 63.245, p < .001$ , partial  $\eta^2 = .650$ , observed power = 1.000), biotechnology ( $F(1,34) = 7.685, p = .009$ , partial  $\eta^2 = .184$ , observed power = .768;  $F(1,34) = 4.446, p = .042$ , partial  $\eta^2 = .116$ , observed power = .535), livestock nutrition ( $F(1,34) = 32.138, p < .001$ , partial  $\eta^2 = .486$ , observed power = 1.000;  $F(1,34) = 23.779, p < .001$ , partial  $\eta^2 = .412$ , observed power = .997), livestock reproduction ( $F(1,34) = 23.041, p < .001$ , partial  $\eta^2 = .404$ , observed power = .997;  $F(1,34) = 5.221, p = .029$ , partial  $\eta^2 = .133$ , observed power = .603), poultry industry ( $F(1,34) = 20.339, p < .001$ , partial  $\eta^2 = .374$ , observed power = .992;  $F(1,34) = 11.584, p = .002$ , partial  $\eta^2 = .254$ , observed power = .911), and agriculture impact

( $F(1,34) = 14.070, p = .001$ , partial  $\eta^2 = .293$ , observed power = .954;  $F(1,34) = 15.682, p < .001$ , partial  $\eta^2 = .316$ , observed power = .970). Specifically, there was a significant increase in these variables from Time 1 to Time 2 and from Time 1 to Time 3. However, no significant increase was found from Time 2 to Time 3.

Research question two sought to evaluate the change in the perception of rural-urban connection among the youth participants. Based on the quantitative analysis, there was a significant quadratic effect on perception of cross-group relationships ( $F(1,33) = 8.31, p = .007$ , partial  $\eta^2 = .201$ , observed power = .799). There was a significant change from Time 1 to Time 2; however, there was no significant increase from Time 2 to Time 3, nor from Time 1 to Time 3. Table 2 outlines the mean scores of all measured variables at each data collection time point.

**Table 2**

*Mean Scores of Youth Participants during the NBYAP Program*

Variable	Time 1	Time 2	Time 3
Agricultural Knowledge			
Agricultural Impact	5.93	6.49 <sup>a</sup>	6.43 <sup>a</sup>
Biotechnology	5.76	6.29 <sup>a</sup>	6.26 <sup>a</sup>
Livestock Nutrition	5.26	6.25 <sup>a</sup>	6.19 <sup>a</sup>
Livestock Reproduction	5.84	6.33 <sup>a</sup>	6.40 <sup>a</sup>
Methane Production	4.46	6.06 <sup>a</sup>	5.96 <sup>a</sup>
Poultry Industry	4.81	5.91 <sup>a</sup>	6.02 <sup>a</sup>
Wheat Production	3.54	6.12 <sup>a</sup>	5.73 <sup>a</sup>
Rural-Urban Connection	6.57 <sup>a</sup>	6.83 <sup>b</sup>	6.70 <sup>a,b</sup>

*Note.*  $N = 35$ . Time 1 occurred at the commencement of the program before the Planting Phase session. Time 2 occurred at the conclusion of the Planting Phase session. Time 3 occurred at the beginning of the Harvesting Phase for the agricultural knowledge constructs. For the rural-urban connection, Time 3 was at the conclusion of the Harvesting Phase. Responses were measured on a seven-point Likert scale ranging from 1 = *strongly disagree* to 7 = *strongly agree*.

<sup>a,b</sup> Shared letters indicate no significant differences (LSD used for pairwise comparisons  $p < .05$ ).

### Qualitative Results

To gain a deeper understanding of the participants' cross-group perceptions, their responses to the open-ended questions after the Harvesting Season were analyzed for emerging patterns. The qualitative findings revealed two themes: "*Breaking Geographic Borders*" and "*Personal Growth*". Participants from both rural and urban areas discussed their increased understanding of people from different backgrounds. Particularly, youth expressed that program participation allowed them to establish meaningful connections with youth from different regions. Further, youth highlighted the developmental benefits of interacting with individuals from diverse backgrounds. Table 3 summarizes the youth participant responses.

**Table 3**

*Cross-group Relationships among Youth participating in NBYAP*

Question	Theme	Representative Responses
<i>What were your biggest takeaways from collaborating with peers from different backgrounds (rural, urban) during the program?</i>	Breaking Geographic Barriers	<i>“I learned that in order to solve big issues, urban and rural kids from different backgrounds need to work together.”</i> - Rural Youth
<i>What new insights did you gain about peers during the six-month NBYAP program?</i>		<i>“That urban and rural students are the same but from different backgrounds.”</i> - Urban Youth
<i>What new insights did you gain about yourself during the six-month NBYAP program?</i>	Personal Development	<i>“I learned that I am way more accepting of urban people than I thought I would be. I made life-long friends in this program both from urban and rural backgrounds.”</i> - Rural Youth <i>“I learned that I truly do love meeting people from all backgrounds, and it reinforced my love for agriculture. It helped clarify some of my goals throughout the year as well.”</i> - Urban Youth

**Discussion**

This research project sought to understand the effect of a PBL youth program on rural and urban youths’ understanding of the agricultural industry along with their cross-group perceptions. As the landscape of American agriculture continues to evolve, it is imperative that youth have an adequate understanding of the technology, processes, and systems that have an impact on our food and fiber industry (Hess & Trexler, 2011). Further, youth need to possess the necessary skills to solve problems combated by the industry (McKim & McKendree, 2020). The findings from this study closely mimic other agricultural-based, PBL youth programs as the NBYAP engendered an increase of agricultural knowledge across all youth (Bush et al., 2019). Specifically, the program effectively increased youths’ understanding of the wheat production process, impact of the agricultural industry, awareness of biotechnology’s relation to the agricultural industry, livestock nutrition and reproduction, the poultry industry, and the role of methane production from the beginning to conclusion of the NBYAP.

4-H programs have played a pivotal role in bridging the gap between rural and urban communities by nurturing a sense of shared purpose, encouraging mutual understanding, and facilitating collaboration between these traditionally distinct environments (Ferrari & Sweeney, 2005; Hobbs, 1999). In this youth program, a positive change in the rural-urban connection occurred from the start to end of the Planting Season; however, there was no change from the end of the Planting Season to conclusion of the NBYAP. This could be attributed to youth already gaining an understanding of the importance of collaboration and connection with their counterparts.

The youth qualitative responses at the conclusion of the program supported the measured perceptions through the rural-urban connection construct. By the NBYAP providing a space for youth from different backgrounds to have both face-to-face and E-contact interactions, the program was able to assist in breaking down biases that youth may have had about their peers. Many youth expressed that the program aided them in recognizing any personal bias that they have held regarding peers who were raised in a different area

than themselves. Youth even found that the collaborative activities that the PBL curricula provided allowed them to create meaningful relationships with their peers. This finding closely aligns with Powell et al. (2022) recommendation for delivering 4-H programming that focuses on providing youth with opportunities to cultivate positive relationships with their peers. Youth revealed that the program provided valuable insight into the importance of working alongside peers with diverse backgrounds and experiences to solve major agricultural issues.

### Conclusion and Implications

As society continues to navigate the evolving landscape of education and the agricultural industry, the integration of PBL into youth programming is a valuable strategy to empower the next generation with the necessary agricultural knowledge and relationships skills needed to combat the pressing issues facing the agriculture. By providing youth development programming that encourages the enrollment of both rural and urban youth, it allowed for the NBYAP to create opportunities for youth from diverse backgrounds to collaborate, learn from one another, and appreciate the interdependence of rural and urban areas. This is not strictly unique to NBYAP as other 4-H programming has encouraged the development of cross-group relationships (Murrah-Hanson et al., 2022). It is essential for 4-H personnel along with youth development researchers to collaboratively continue to evolve curricula that simultaneously allows youth to dissect 21st century problems while networking with their peers (Bush et al., 2019). It is recommended that Extension personnel and agricultural educators utilize the pilot of the Texas NBYAP as a guide when developing innovative youth programs that have a focus on cultivating unity by transcending rural-urban boundaries. Ultimately, this contributes to the development of youth that possess the ability to generate cross-group relationships. The outcomes of this study provide practical insights for policymakers, agricultural educators, and community leaders seeking effective strategies to build a sense of cohesion across diverse groups.

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