

# Connecting Problem-solving Style to Peer Evaluations of Performance in Secondary Cooperative Learning Projects

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## Abstract

*With an evolving and expanding agricultural industry, it is crucial to provide future professionals with valuable experiences and skills in problem solving, communication, and teamwork. Agricultural summer programs for secondary students, which provide cooperative learning experiences with a focus on group work and problem solving, aim to help meet the current demand of employment in the various disciplines within agriculture. Many of these summer programs offer secondary students opportunities to learn more about agriculture, and gain experiences as they work in teams to consider the agricultural issues they may face upon entering the workforce. While adaptation-innovation theory has been used in agribusinesses across the world to provide explanation to how people work together in teams to solve complex ill-defined problems, little is known regarding the degree the theory applies to secondary student learning in groups. This study utilized a quantitative, quasi-experimental design to further explore how high school students' problem-solving styles impact their perceptions of group members in a cooperative learning experience while participating in the Virginia's Summer Residential Governor's School for Agriculture program. The findings and recommendations can assist instructors in providing cooperative learning experiences to their students and further maximize high school student's experiences in working in teams and solving complex ill-defined problems associated with agricultural issues.*

**Key Words:** Problem-solving; cooperative learning; peer evaluation; teamwork; communication

## Introduction

As agriculture continues to evolve and expand, the demand for qualified professionals with valuable experience and skills, beyond content knowledge, continues to grow. Amongst these abilities are problem solving, communication, and team skills (Crawford, Lang, Fink, Dalton, & Fielitz, 2011). Agricultural summer programs for gifted high school students aim to provide hands on experiences and agricultural literacy, regarding job possibilities within the agricultural sector, to aid in meeting this demand (Cannon, Broyles, Seibel, & Anderson, 2006). These programs should include cooperative learning strategies, which allow students to solve complex problems

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within a small group. Literature has demonstrated that cooperative learning can be a superior approach to individualistic learning strategies (Gunderson & Moore, 2008; Rau & Heyl, 1990; Springer, Stanne, & Donovan, 1999). Rau and Heyl (1990) stated “isolated students do not learn as much or as well as students who are embedded in a network of informal social relations” (p. 144). Further, cooperative learning allows for students engage in group work that leads to greater achievement of problem solving and teamwork skills, which provide students with transferable skills to the workforce (Oakley, Felder, Brent & Elhaji, 2004).

While students work together in cooperative learning groups, many variables have been considered to explain how students solve problems together in teams, but one variable often not considered is each student’s problem-solving style. Adaption-innovation (A-I) theory (Kirton, 2011) provides explanation for how individuals, along a continuum, solve problems with a predictable stylistic preference; either more adaptively or more innovatively. Further, this stylistic difference in solving a problem may cause conflict within groups due to disagreement in how the problem should be solved (Kirton, 2011). Research on problem-solving style has examined how groups work together (Buffington, Jablow, & Martin, 2002; Buttner & Gyskiewicz, 1993; Goldsmith, 1984; Hutchinson & Skinner, 2007; Kaufman, 2004).

However, there is a gap in the literature with regard to problem-solving style at the secondary education level. Further, the National Research Agenda for Agricultural Education, calls for additional research regarding advance practices and programs which increasing problem-solving, transfer of learning, and higher order thinking within agricultural contexts (Doerfert, 2011). In order to fully support agricultural students at the secondary level, agricultural education professionals need to understand how these students learn while solving problems in teams with respect to the variable, problem-solving style. Therefore, a study exploring how the problem-solving styles of high school students influence their perceptions of group members during a cooperative learning experience may begin to provide insight into teaching strategies and learning strategies for the advancement of learning while solving problems.

### **Theoretical Framework**

A-I theory is the only known theoretical framework linking an innate characteristic of personality to a predictable style to solving problems and managing change (Friedel, 2014). Because problem solving is the highest form of thinking the human brain can perform (Gagne, 1965), and performed by all people, A-I theory may help us better understand not only how people solve problems, but also provide insight to how individuals work in teams to solve problems together. Disagreements between group members often arise because of our different perspectives of the problem, which leads to a disagreement to how the problem should be solved. A-I theory purports one variable to consider, but often ignored, is the influence of problem-solving style while solving problems in groups (Kirton, 2011). This gives reason to investigate the implications of problem-solving style in problem solving environments, such as the use of cooperative learning as an instructional strategy.

### **Adaption-Innovation Theory**

Kirton’s A-I theory (1976) is based on the fact that we as humans are all problem solvers and “problem solving is the key to life” (Kirton, 2011, p. 8). Humans are always solving problems at various levels of complexities and utilizing various types of styles. Further, the problem-solving process is inherently linked to the management of change, which is key to connecting how an individual may prefer to solve a problem, and getting others to agree to the same approach. In the simplest explanation of the management of change, Lewin (1947) suggested change was the

movement between unfreezing the current state of performance, making a change, and refreezing the state at the desired level of performance. The process of making a change requires identifying the problem within the current state, generating solutions to address the identified problem, evaluating solutions to identify the best solution to the problem, and implementing the solution to change the current state; that is, the problem solving process (Pretz, Naples, & Sternberg, 2003). Once this state has been changed, it is to be refrozen, as agreed upon and maintained by the group. As humans we must constantly adapt to the changes around us to survive, which includes the problems solved by others in a style that may not be similar with one's own style. In turn, this means that no human can experience no change, and humans perpetually manage change as problems continue to be solved.

During the process of solving a problem, one begins by identifying a problem within the environment that may not be in line with desired needs, values, attitudes or beliefs (cognitive affect; Kirton, 2010). Once the problem has been identified, an individual will use knowledge, experience, and learned skills (cognitive resource; Kirton, 2010) to determine a solution to address the problem. The solution is then implemented with a designated style (either more adaptive or more innovative) and at a designated level (low complexity or high complexity). Both level and style are situated in cognitive effect (Kirton, 2010) and independent of cognitive affect and cognitive resource, but all within cognitive function of the brain (Kirton, 2010). Kirton uniquely places problem-solving style within the domain of cognitive effect, and has provided ample evidence problem-solving style has no relationship with measures of intelligence, motivation, education, culture, age, and ethnicity (Kirton, 2011). This distinction and independence between cognitive resource, affect, level and style is significant as many measures of "learning style" or "cognitive style" are not a pure measure of style (Coffield, Moseley, Hall, & Ecclestone, 2004). One's problem-solving style is innate, stable, and easily measured along a continuum utilizing the KAI (Kirton, 2010). Because the KAI is a pure measure of style, we can identify when style may be contributing to the phenomena of study and when it does not.

A-I theory highlights the salient aspects of problem-solving style, which is defined as, "the strategic, stable characteristic- the preferred way in which people respond to and seek to bring about change" (Kirton, 2011, p.43). One's problem-solving style may be measured by completion of the KAI, which provides a score along an interval scale anchored by adaption on the left and innovation on the right (see Figure 1).

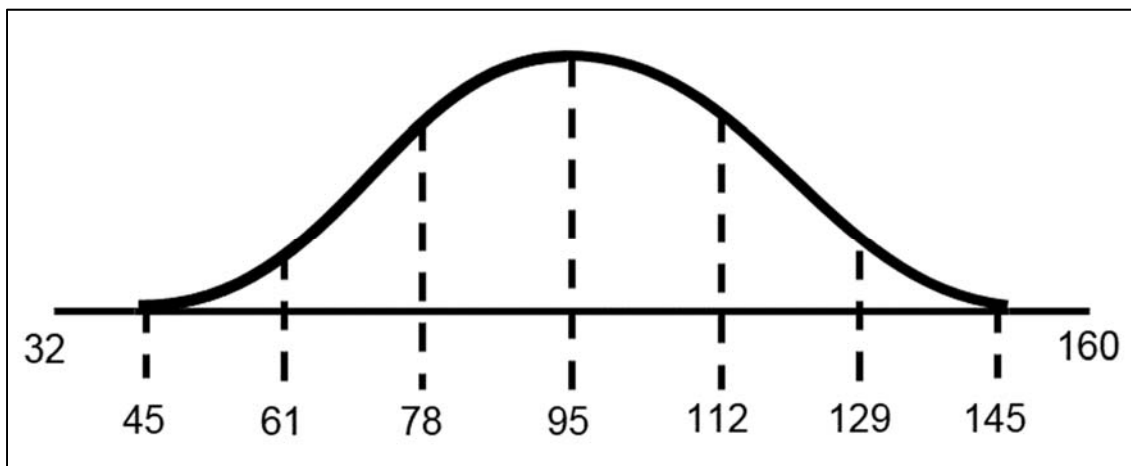


Figure 1. General population of KAI scores along the continuum of problem solving more adaptively or more innovatively.

Those who fall on the more adaptive side of the continuum prefer more structure and tend to produce fewer ideas within the paradigm for the purpose of improving efficiencies. Those who are on the more innovative side of the continuum prefer less structure and tend to generate many ideas to alter the paradigm for the purpose of making the paradigm different (Kirton, 2011). Again, one's preferred style in solving problems is not related to measures of motivation or intelligence, thus the scale is non-pejorative in indicating a flawed or optimum style. With the general population mean situated at 95 points, those with less than 95 points on the KAI are more adaptive to the general population, and those with more than 95 points are more innovative. The theoretical range of the continuum is between 32 and 160 points. It is important to note, however, in distinguishing if one is more adaptive or more innovative it is often more relevant to determine where one is situated on the continuum based on individuals in one's group as opposed to the general population. For example, one may have a score of 125 points indicating the individual is more innovative. However, if this individual is placed in a group with two other individuals with scores of 132 and 142 points, the individual scoring 125 points is the most adaptive individual in the group. This indicates that an individual's contribution to the group may vary depending on the makeup of the group.

While one's problem-solving style measured by the KAI is a preferred style, one may operate outside one's preferred style. For example, someone with a KAI score of 89 may choose to operate more adaptively along the continuum at 65 points, or more innovatively along the continuum at 121 points. Kirton (2011) has termed this as coping behavior, which is a learned skill to solve problems outside one's preference. For one to begin to use coping behavior, there must be an awareness of a need to cope based on the needs of the problem and one must be motivated to cope outside of one's preferred problem-solving style (Kirton, 2011). Coping becomes learned as one discovers through solving a problem that operating more adaptively or more innovatively may be effective in solving the specific current problem. However, the motivation required to exhibit coping behavior is taxing to cognitive function, and so one may only cope for a limited amount of time and limited intensity (either more adaptive or more innovative) before an individual determines there is no more justification to cope.

Individuals who share the same problem-solving style tend to communicate effectively with each other, work well together, and trust each other (Kirton, 2011). Therefore, reason exists to believe A-I theory has implications towards the group dynamics associated with cooperative learning and solving problems together. In adaption-innovation theory, Kirton (2011) describes all individuals as agents of change and has denoted everyone as an AC<sup>1</sup> based on the assumption that all humans are creative and can solve problems, with a preference towards solving problems more adaptively or more innovatively. Individuals who are in a group and 10 points on either side of the group mean, either being more adaptive or more innovative, are characterized as an AC<sup>2</sup>, which indicates this individual(s) has a mild adaptive or innovative preference with respect to the group (Kirton, 2011). Individuals who are beyond 10 points, either being more adaptive or more innovative of the group mean, are characterized as an AC<sup>3</sup>, or individual(s) who are more extreme in preference to be more adaptive or innovative with respect to the group (Kirton, 2011). So, everyone is an AC<sup>1</sup> as a result of being a problem solver, and depending on one's position on the adaption-innovation continuum in relation to the mean KAI score of the group, one also may be an AC<sup>2</sup> or an AC<sup>3</sup>. It is likely while working in any organization with many groups, one may switch from being an AC<sup>2</sup> to an AC<sup>3</sup>, and vice versa, depending on the mean score of each group; assuming there are three or more members per group (Kirton, 2011). For example, any team member with any KAI score being a member of three different teams; in one is an AC<sup>2</sup>, and the other two an AC<sup>3</sup>, with the possibility of being an adaptive AC<sup>3</sup> or an innovative AC<sup>3</sup>.

Applying the concept of AC<sup>2</sup> and AC<sup>3</sup> further to the context of a functioning team, more may be explained in how the team prefers to solve problems. The AC<sup>2</sup> group of a team includes individuals who collectively form a consensus group, which holds power due to a typically larger number of individuals (often approximately 40%) who have a shared belief on how problems should be solved (Kirton, 2011). AC<sup>3</sup> individuals, naturally outside the consensus group, theoretically must utilize coping behavior to interact with the group. The AC<sup>3</sup> individuals offer the most cognitive diversity to the group due to their preferences to solving problems more adaptively or more innovatively. However, AC<sup>3</sup>s often are not valued in the group because they prefer to solve the problem differently than the consensus group of AC<sup>2</sup>s (Kirton, 2011). While many KAI practitioners anecdotally have found this to be true, little empirical evidence exists examining the interaction of AC<sup>2</sup>s and AC<sup>3</sup>s in functioning groups; which gives rise to the importance of this study.

Every place on the adaption-innovation continuum has its own strengths and weakness, but most individuals have the commonality of finding it difficult to see each other's perspective with respect to problem-solving style (Kirton, 1980). This difficulty, which leads to conflict, may be one of many conflicts which contribute to what Kirton (2011) refers to as a Problem B. If Problem A is the original agreed upon problem to solve as a group, Problem Bs are the problems occurring within the group which deter progress made in solving Problem A and in which the solution presented only benefits one person or a few members of the group at the expense of fellow group members. Note that there is only one Problem A, but there may be many Problem Bs; such as problems resulting from personal conflicts, political gaming, or lack of resources. Because everyone has a preference to solve the problem in one's own way, Problem Bs are inevitable, and must be mitigated, to continue work on solving Problem A (Kirton, 2011). Many groups struggle to focus on Problem A due to Problem Bs, which is caused by inner group issues that arise from the failure to manage diversity within a heterogeneous group (Kirton, 2011). Heterogeneous groups are predicted to be more successful during large-scale complex problem solving, if the cognitive diversity with respect to problem solving style is effectively leveraged, but the group must work to overcome team dissonance to achieve success of solving Problem A (Buffington et al., 2002; Kirton, 2011).

### **Group Learning Pedagogy**

While some authors have viewed collaborative learning, cooperative learning, peer learning, and group work as synonymous terms within group learning pedagogy, which involves students teaching each other through work in small teams (Gunderson & Moore, 2008), there are distinct differences between these pedagogical methods. Eggen and Kauchak (2001) differentiate these social interaction methods (also known as collaborative learning methods) by purpose and size of the group. Cooperative learning methods include teaching strategies providing structure for students with roles and goals for the intact group to operate in longer periods of time, such as a semester (Eggen & Kauchak, 2001). Popular examples of cooperative learning models include Student Teams Achievement Divisions (Slavin, 1995), and Jigsaw II (Slavin, 1986). This method is different than group work, which includes strategies to supplement different learning approaches by getting students to work and think together (e.g. think-pair-share; see Kagan, 1994). A discussion, used as an instructional strategy, is when students share ideas with each other to engage in higher-level thinking without the structure of cooperative learning (Eggen & Kauchak, 2001). This may often occur in groups, or as an entire class, and typically is used during a class period; either led by the instructor or by student peers.

Cooperative learning is one of the most used and favored active learning pedagogical strategies in education because it gives students the opportunity to gain valuable information

through interaction with their peers and environment (Tsay & Brady, 2010). This interaction allows an opportunity for a student's social skills to be enhanced within a setting where they are able to express their opinions, whether they be conflicting or in agreement with team members. This process forces students to think outside of their own paradigms and gain further perspectives through group discussions (Tsay & Brady, 2010). Cooperative learning is based on the old adage that two heads are better than one (Johnson & Johnson, 1999). In order for the learning group to be considered cooperative learning, there must be shared goals and beneficial outcomes for all members. Additionally, these team members must support and encourage each other, which should lead to higher academic performance (Johnson & Johnson, 1999). Not all instances where students are placed on a team are classified as cooperative learning experiences.

Cooperative learning occurs when the following five basic elements occur: positive interdependence, individual accountability, face-to-face promotive interaction, social skills, and group processing (Johnson & Johnson, 1989). Positive interdependence occurs when a student believes they cannot succeed unless the whole group succeeds, which is normally based on reaching a common goal. Students must also be assessed individually and receive their scores for individual accountability to take place. Face-to-face promotive interaction then occurs through actively encouraging and supporting each other's efforts. The students must possess social skills, which aid in collective decision making. All of these elements allow group processing to occur, where the students discuss their progress towards their goals without negatively impacting group relationships (Johnson & Johnson, 1989).

Group processing may also be associated with Tuckman's Stage of Development Model, which includes the forming, storming, norming, and performing stages (Tuckman, 1965). A group must become familiar with each other and the standards of their team. The storming stage then occurs where conflict transpires and causes the group to suffer from the adversity (Tuckman, 1965). The norming stage brings about a feeling of cohesiveness and leads the team to the performing stage. In the performing stage, the group utilizes their team structure to aid in problem solving efficiency (Tuckman, 1965). A team must complete all stages of Tuckman's Stage of Development Model to achieve group processing and truly engage in cooperative learning.

### **Purpose & Objectives**

The purpose of this study was to determine if there are significant differences in how students evaluate peers' performance with respect to their preferred problem-solving style while completing a cooperative learning experience while participating in the Virginia's Summer Residential Governor's School for Agriculture (GSA) program. The study was guided by the following objectives:

1. Describe the problem-solving styles of secondary students enrolled in the GSA.
2. Describe secondary students' perceptions of fellow group members in the GSA.
3. Examine the differences between secondary students as agents of change and their perceptions of group members.
4. Examine the differences between secondary students grouped by problem-solving style and their perceptions of group members.

### **Methods**

The target population in this study consisted of high school junior and seniors ( $N = 100$ ) participating in a four week residential agricultural education program. The student ages ranged

from 16 to 18 years old and were accepted into the program based on an application process. These students were keyed gifted and talented students from Virginia who had interests in obtaining a career in the agricultural industry. The program incorporated student-centered teaching and a cooperative learning research project to provide hands-on learning experiences, improved agricultural literacy, and development of agricultural-based skills for STEM-based agricultural careers needed in a wide array of fields within the agricultural industry.

This study utilized a quantitative, quasi-experimental design (Ary, Jacobs, Sorensen, & Walker, 2013). Prior to the start of the program, participants completed the KAI and researchers organized students into ten homogeneous and ten heterogeneous teams based on problem-solving style to complete a cooperative learning research project for the duration of the GSA. Due to the large diversity of problem-solving styles of the GSA students, the researchers were limited in the ability to develop homogeneous teams with team members having a maximum 20-point difference of each other's KAI results. Deciding on a maximum of a 25-point spread of KAI points in homogeneous groups, ten homogeneous teams were created with similar problem-solving styles, and remaining students were placed in heterogeneous teams. Out of the 100 students enrolled in GSA, 70 had signed consent forms from guardians and agreed to participate in the study, leaving intact 14 participating teams: ten heterogeneous and four homogeneous.

The cooperative learning project used at GSA provided students with an opportunity to examine a real-world agricultural issue related to NIFA priority research areas and identify solutions based on academic literature. Students met regularly for several hours during weekday afternoons as a team during the four-week period of the program. Students developed a white paper, poster, and presentation based on their team findings. Examples of research questions posited to students included: What agronomic practices would improve the rate of carbon sequestration? What strategies could be used to make high quality local food accessible and available to the low income segments of a community? What scientific advances are necessary to make perennial grasses a sustainable energy crop?

After week one of the program, participants received their KAI feedback. The KAI is comprised of 32 assessment items, allowing participants to respond to statements indicating their preference on a Likert-type scale ranging from very hard to very easy on a continuum. A variety of studies have established the reliability of the KAI with reliabilities ranging from .74 to .86 for adolescents (Kirton, 2011).

After week two, estimated to be the storming phase of group development (Tuckman, 1965), a peer evaluation form was given to participants of each team, which requested that the students rank their team members on performance. Students were asked to evaluate each team member based on the extent to which he/she participated and communicated, prepared, helped the group excel, and was a team player. The scale ranged from 4 – *Usually (over 90% of the time)*, 3 – *Frequently (more often than not)*, 2 – *Sometimes (less than half of the time)*, 1 – *Rarely (never or once in a great while)*. Participation and communication was described as the extent to which a team member articulates their ideas effectively, while listening and encouraging others. Preparation involved being on time for team meetings and having read and completed all prior assignments. Expressing interest in the group's success, initiating problem solving, influencing high standards for the group, and staying motivated towards success were all factors in helping the group excel. A team player was described as someone who knows when to be a leader and a follower, keeps an open mind, compromises when appropriate, can take criticism, and shows respect for others. These four constructs were developed to examine cooperative learning elements within the teams. Based on the explanations, cooperative learning should be occurring if the elements are met consistently by a team. The cooperative learning scale had a Cronbach's alpha of .79.

**Data Analysis**

Descriptive statistics were utilized to describe scores and perceptions of group members. A participant’s classification as an agent of change was determined by their distance on the continuum from their group’s average KAI score; AC<sup>2</sup> being 10 points or less from the group’s average KAI score and AC<sup>3</sup> being more than 10 points from the group’s average KAI score, respectively. Additionally, independent *t*-tests were used to determine whether a difference existed between high school students as agents of change and their perceptions of group members and high school students grouped by problem-solving style and their perceptions of group members. The independent *t*-test was used to demonstrate the significance of findings (*p* < .05).

**Results**

Objective one focused on describing the problem-solving styles of high school students in GSA. Problem-solving style scores were determined from each participant’s results on the KAI. The problem-solving scores for high school students participating in GSA ranged from 53 to 123 on the continuum with a mean score of 90.80 points. The mean for problem-solving style (*M* = 90.80, *SD* = 17.49) was slightly more adaptive than the general population average of 95 points (Kirton, 2011).

Objective two concentrated on describing high school students’ perceptions of group members during GSA. To investigate participants’ perceptions of group members, participants completed a peer evaluation for each member of their group. These evaluations utilized a four-point scale (4 – *Usually*, 3 – *Frequently*, 2 – *Sometimes*, 1 – *Rarely*) to determine how a group member contributed to the team, and theoretically, how often cooperative learning occurred. Each group member’s average score was calculated for each construct. Each individual’s average was utilized to find the descriptive statistics for the group. The peer evaluations demonstrated that the members frequently met the standards of the group in regards to cooperation (*M* = 3.69, *SD* = .46), helping the group to excel (*M* = 3.60, *SD* = .42), participation and communication (*M* = 3.53, *SD* = .46), and preparation (*M* = 3.69, *SD* = .38). In addition, overall peer evaluations scores (*M* = 3.63, *SD* = .34) indicated that group members frequently participated in cooperative learning (see Table 1).

Table 1

*Perceptions of Group Members based on Peer Evaluation Scores (n = 70)*

	M	SD
Overall Peer Evaluation Score	3.63	.34
Team Player (Cooperation)	3.69	.46
Helps Group Excel	3.60	.42
Participation & Communication	3.53	.46
Preparation	3.69	.38

Note. Scale: 1 = Rarely, 2 = Sometimes, 3 = Frequently, 4 = Usually



Objective three aimed to examine the differences between high school students as agents of change and their perceptions of group members. Participants were classified as agents of change in relation to their problem-solving scores distance on the continuum from their group’s average KAI score. AC<sup>2</sup> (*n* = 41) students were those who were 10 points or less from their group’s average, and AC<sup>3</sup> (*n* = 29) students were those who were more than 10 points from their group’s average, respectively; either adaptively or innovatively. There was no statistical difference between high school students as agents of change and their perceptions of group members (see Table 2). This finding may be due to a lack of statistical power in the analysis as a result of a smaller sample size.

Table 2

*Differences between High School Students as Agents of Change and their Perceptions by Group Members*

	n	M	SD	t	p	Cohen’s <i>d</i>
Overall Peer Evaluation Score						
AC <sup>2</sup>	41	3.63	.310	.275	.784	.06
AC <sup>3</sup>	29	3.61	.380			
Team Player (Cooperation)						
AC <sup>2</sup>	41	3.68	.399	-.138	.891	.30
AC <sup>3</sup>	29	3.55	.459			
Helps Group Excel						
AC <sup>2</sup>	41	3.63	.399	.739	.462	.19
AC <sup>3</sup>	29	3.55	.459			
Participation & Communication						
AC <sup>2</sup>	41	3.55	.408	.493	.624	.11
AC <sup>3</sup>	29	3.50	.521			
Preparation						
AC <sup>2</sup>	41	3.67	.422	-.228	.820	.05
AC <sup>3</sup>	29	3.69	.329			

*Note.* Significance at the \**p* < .05 and \*\**p* < .01 level, 2-tailed.

Peer Evaluation Scale interpreted: 1 = Rarely, 2 = Sometimes, 3 = Frequently, 4 = Usually

Objective four sought to examine the differences between high school students grouped by problem-solving style and their perceptions of group members. There were four homogenous teams ( $n = 20$ ) that were designed to have a 25 point spread or less on the KAI continuum. Ten heterogeneous teams ( $n = 50$ ) were created to observe differences between homogeneous and heterogeneous teams regarding their perceptions of fellow group members working as a team. Homogenous teams received higher overall peer evaluation scores ( $M = 3.70, SD = .115, p = .019$ ) than heterogeneous teams. Homogenous teams also had higher scores for participation and communication ( $M = 3.65, SD = .149, p = .001$ ) and preparation ( $M = 3.80, SD = .130, p = .001$ ) which were found to be statistically significant different from the heterogeneous groups. Further, a moderate effect size ( $d = .65$ ) was found examining the difference between groups regarding overall peer evaluations, and large effect size was found between groups regarding being a team player ( $d = .78$ ), participation and communication ( $d = .78$ ) and preparation ( $d = .98$ ); all indicating practical significance. (see Table 3).

Table 3

*Differences between High School Students Grouped by Problem-Solving Style and their Perceptions by Group Members*

	n	M	SD	t	p	Cohen's d
Overall Peer Evaluation Score						
Homogenous Groups	20	3.70	.115	2.41	.019*	.65
Heterogeneous Groups	50	3.60	.183			
Team Player (Cooperation)						
Homogenous Groups	20	3.74	.199	1.28	.206	.78
Heterogeneous Groups	50	3.59	.245			
Helps Group Excel						
Homogenous Groups	20	3.61	.111	.53	.600	.12
Heterogeneous Groups	50	3.59	.245			
Participation & Communication						
Homogenous Groups	20	3.65	.149	3.39	.001**	.78
Heterogeneous Groups	50	3.49	.249			
Preparation						
Homogenous Groups	20	3.80	.130	3.45	.001**	.98
Heterogeneous Groups	50	3.64	.190			

*Note.* Significance at the  $*p < .05$  and  $**p < .01$  level, 2-tailed.

Peer Evaluation Scale interpreted: 1 = Rarely, 2 = Sometimes, 3 = Frequently, 4 = Usually

### **Conclusions**

The findings for problem-solving styles among high school students in GSA were consistent with previous literature demonstrating a mean that was slightly more adaptive than the general population average, but still considered, on average, a same score (Kirton, 2011). Same scores are described as those with less than a 10 point differential on the adaption-innovation continuum. The range of scores for these students was 53 to 123 points, which fell within the typically observed range of 45 to 145 points (Kirton, 2011). Based on these findings, it can be concluded that high school students in GSA were similar to the general population, but it should be noted they were a self-selected population.

Cooperative learning occurs when students work together in a group to obtain knowledge and work towards a common goal within an educational context (Tsay & Brady, 2010). The results from the peer evaluations provide an indication cooperative learning occurred frequently by meeting all five of the basic elements set in place in the pedagogy (Johnson & Johnson, 1989). Positive interdependence was viewed in relation with helping the groups excel, where students worked together towards a common goal. By examining preparation, individual accountability was able to be detected by the standards one held. The face-to-face promotive interaction was observed through communication and participation by listening and encouraging others. In order to be considered a team player, individuals had to uphold social skills. Students in GSA were expected to partake in group processing following completion of the peer evaluations. Overall, the peer evaluations indicated frequent positive interactions within a group, which supported the elements of the cooperative learning pedagogy.

Students as AC<sup>3</sup>s compared to AC<sup>2</sup>s in this program failed to show a statistically significant difference ( $p > .05$ ) on their perceptions of each other with respect to peer evaluations. Since AC<sup>3</sup> fall outside of the consensus group of problem-solving style, it could be assumed that these students would experience more dissonance due to having to utilize coping behavior. This could indicate that all group members experience conflict in comparable measures, regardless of one's role as an agent of change. However, considering these students chose to apply for GSA and were high achieving students, high motive may have played a role in the findings, which leads to coping outside one's preferred problem-solving style (Kirton, 2011). Motive may be defined as "the process by which energy is mobilized, gathered, and directed towards a goal" (Kirton, 2011, p. 93). Motive is necessary for coping behavior (Kirton, 2011), and the high mean scores of all peer evaluation scales indicates these students were all willing to work with each other to complete the assigned research project. That is, perhaps all members of the teams were exhibiting some coping behavior. Participants were all looking to gain further knowledge and experiences through GSA, as well as complete the research project by the end of the program, so motive may have been higher than usual within this group. In essence, these students were motivated and willing to learn to collaborate and insightfully exhibited coping behavior, realizing that diversity of thought among fellow problem solvers was beneficial to addressing large and complex problems.

In A-I theory, heterogeneous groups are better able to solve complex problems through mutual respect of team members and utilization of a various problem-solving styles outside of the consensus group (Buffington et al., 2002; Kirton, 2011). However, consistent with previous literature, homogenous groups among high school students at GSA had higher scores in all peer evaluations categories and statistically significant higher frequency in participation and communication, preparation, and their overall peer evaluation scores. Because homogeneous groups think alike, and prefer to solve problems in the same manner, they likely would evaluate each other higher in ability for communication of ideas and preparation to solve the problem. A heterogeneous group has to manage the diversity of the problem and diversity of the problem-

solvers (Kirton, 2011) while solving the problem. Kirton (2011) explains that heterogeneous groups may focus more on the issues between problem-solvers than the problem at hand. Based on the findings, it can be concluded that these secondary students in GSA placed in homogeneous groups perceive their group members in higher regard than the heterogeneous groups. This significant finding was despite the high evaluation perception scores students generally gave fellow team members in the program. Note, however, that this study did not examine any differences in the quality of the final products delivered by the cooperative learning teams.

### **Implications & Recommendations**

Although the findings of this study are limited specifically to the population of high school students in GSA and not generalizable to a larger group, there are still several implications and recommendations for future practice and research. The literature on cooperative learning demonstrates how students are able to learn transferable skills, achieve higher levels of learning, and retain information for longer periods of time (Oakley et al., 2004). This study utilized a cooperative learning activity, which was incorporated into a high school residential, agricultural summer program. The high means of peer evaluations provided implications that the cooperative learning strategies were successful with this group. Cooperative learning strategies could be utilized in other similar programs, where the instructor actively works to competently assign students to groups and promote positive interdependence, individual accountability, face-to-face promotive interaction, social skills, and group processing (Johnson & Johnson, 1989).

Further, these cooperative learning experiences should be utilized to educate students on how to collaborate with others and overcome team dissonance. Working in heterogeneous groups will always provide some form of discomfort to team members. However, heterogeneous groups are essential for solving complex problems so that various perceptions of the problem may be discussed and the problem may be best solved (Kirton, 2011). It is not enough to teach a group to solve a problem; rather, students must also learn the skills and dispositions necessary to solve problems together. For example, self-actualization, when related to one's problem solving, may not help an individual learn how to cope, but may provide the individual insight to judge when one is coping or needs to cope (Kirton, 2011). Teaching these skill sets to high school students may maximize their cognitive function and contribute to their future success working in teams and making contributions to society. The expanded skill sets in problem solving, communication, and teamwork skills will provide high school students with the experiences needed to be successful within their future careers and in turn promote the expansion of the agricultural industry.

Based on the findings and a lack of research focusing on differences between AC<sup>2</sup>s and AC<sup>3</sup>s in A-I theory, further research should be conducted on how the individuals experience discord within a group. Theoretically, an AC<sup>3</sup> outside of the subset of consensus may experience more disharmonies and have to partake in coping behavior more regularly. However, this study provides indication students exhibited coping behaviors regardless of their role as an agent of change, as AC<sup>2</sup>s and AC<sup>3</sup>s generally perceived each other to be working with each other on the team. Based on the factor of motive contributing to coping behavior, this study was unable to make any definite conclusions related to this phenomenon, which calls for additional exploration.

Significant differences were found between the homogeneous and heterogeneous groups with respect to their overall peer evaluation scores, participation and communication, and preparation. While more research is needed to determine if these findings may be replicated in other agricultural education programs, these findings were anticipated given A-I theory. This said, there was no measure of the quality of the final research projects reported in this study. While like-minded individuals who prefer to solve the problem similarly often communicate with each other

well, work well together, and trust each other more (Kirton, 2011), this does not mean the solution to the proposed research problem assigned to the groups was the most appropriate solution. Professionals in agricultural education should avoid grouping students with similar problem-solving styles for the purpose of creating well-working teams, because the solution generated by the group will likely not include the diversity of thought provided by more adaptive and more innovative individuals. This said, research is warranted to look beyond theoretical and anecdotal evidence for the purpose of determining how different the quality of final products may be between homogeneous and heterogeneous groups.

Future research should be conducted to look at a larger sample size across multiple like programs with high school students interested in obtaining careers in the agricultural industry. Additionally, qualitative methods should be utilized to receive a better understanding of perceptions of group members and their interactions. Discovering more about how adolescents utilize and perceive their own problem-solving style and the problem-solving styles of team members could provide further insight into the development of technologies for teaching problem-solving and a higher order of thinking within high school agricultural contexts and better preparing incoming professionals for the agricultural industry.

Commonly we think of a clash between two individuals in a group being associated with differences in proficiency or rank within the group. Kirton (2011) has observed that individuals with different problem-solving styles also tend to clash instead of collaborate. That is, clash may occur when a group of individuals with the similar problem-solving styles think of those who have different problem-solving styles as inferior. In a cooperative learning experience, this may happen when those who want to solve the problem one way are too safe, and those who think otherwise are not safe enough. Agricultural educators wishing to improve their use of cooperative learning pedagogy may find A-I theory (Kirton, 2011) useful in informing their practice. Going back to Problem A and Problem B, there is less likelihood for the group to clash if there is agreement from the start to collaborate. A Student who has a different problem-solving style may be included as a special contributor, instead of an outsider. Special contributors have the benefit of contributing useful information when needed. Agreement to the process in solving Problem A, with mutual respect of group members' ideas, will assist students in mitigating Problem Bs (Kirton, 2011). To take this implication further, recognizing that we each have an innate problem-solving style, we all have advantages and disadvantages to how we each perceive Problem A. Because neither the more adaptive or more innovative is better at solving problems, agricultural educators may help students recognize the value each group member brings to working together and solving Problem A.

### **References**

- Ary, D., Jacobs, L., Sorensen, C., & Walker, D. (2013). *Introduction to research in education*. Cengage Learning.
- Buffington, K.W., Jablow, K. W., & Martin, K. A. (2002) Project team dynamics, and cognitive style. *Engineering Management Journal*, 14(3), 25-33.
- Buttner, H., & Gyskiewicz, N. (1993). Entrepreneurs' problem-solving styles: An empirical study using the Kirton adaption-innovation theory. *Journal of Small Business Management*, 31(1), 22-31.
- Cannon, J. G., Broyles, T. W., Seibel, G. A., & Anderson, R. (2009). Summer enrichment programs: Providing agricultural literacy and career exploration to gifted and talented students. *Journal of Agricultural Education*, 50(2), 27-38.

- Coffield, F., Moseley, D., Hall, E., & Ecclestone K. (2004). Learning styles and pedagogy in post-16 learning: A systematic and critical review. London: Learning and Skills Research Centre.
- Crawford, P., Lang, S., Fink, W., Dalton R., & Fielitz, L. (2011). Comparative analysis of soft skills: What is important for new graduates? Washington, DC: Association of Public Land-grant Universities.
- Doerfert, D. L. (Ed.). (2011). National research agenda: American Association for Agricultural Education's research priority areas for 2011-2015. Lubbock, TX: Texas Tech University, Department of Agricultural Education and Communications. Retrieved from [http://aaaeonline.org/files/research\\_agenda/AAAE\\_NRA\\_\(2011-15\)\\_full\\_report.pdf](http://aaaeonline.org/files/research_agenda/AAAE_NRA_(2011-15)_full_report.pdf)
- Eggen, P. D., & Kauchak, D. P. (2001). Strategies for teachers: Teaching content and thinking skills. Prentice Hall.
- Friedel, C. (2014). The value of adaption and innovation as a function of diversity. In N. Erbe (Ed.) Approaches to managing organizational diversity and innovation (p. 63-81). Hershey, PA: IGI Global. Retrieved from <http://www.igi-global.com/chapter/the-value-of-adaption-and-innovation-as-a-function-of-diversity/108471>
- Gagne, R. M. (1965). The conditions of learning. New York: Holt, Rinehart and Winston.
- Goldsmith, R. E. (1984). Personality characteristics associated with adaption-innovation. *Journal of Psychology*, 117, 159-165.
- Gunderson, D. E., & Moore, J. D. (2008). Group learning pedagogy and group selection. *International Journal of Construction Education and Research*, 4(1), 34-45.
- Hutchinson, L. R., & Skinner, N. F. (2007). Self-awareness and cognitive style: Relationships among adaption-innovation, self-monitoring, and self-consciousness. *Social Behavior and Personality: an international journal*, 35(4), 551-560.
- Johnson, D. W., & Johnson, R. (1989). Cooperation and competition: Theory and research. Edina, MN: Interaction Book Co.
- Johnson, D. W., & Johnson, R. W. (1999). Making cooperative learning work. *Theory into Practice*, 38(2), 67-73. doi: 10.1080/00405849909543834
- Kagan, S., (1994). Cooperative learning. San Juan Capistrano, CA: Resources for Teachers.
- Kaufmann, G. (2004). Two kinds of creativity- But which ones? *Creativity and Innovation Management*, 13(3), 154-165.
- Kirton, M. (1976). Adaptors and innovators: A description and measure. *Journal of Applied Psychology*, 61(5), 622.
- Kirton, M. J. (1980). Adaptors and innovators in organizations. *Human Relations*, 33(4), 213-224. doi:10.1177/001872678003300401

- Kirton, M. J. (2011). *Adaption-innovation: In the context of diversity and change*. New York, NY: Routledge.
- Kirton, M. J. (2010). *KAI theory workbook*.
- Oakley, B., Felder, R., Brent, R., & Elhaji, I. (2004). Turning student groups into effective teams. *Journal of student Centered Learning* 2(1), 9-34.
- Pretz, J. E., Naples, A. J., & Sternberg, R. J. (2003). Recognizing, defining, and representing problems. In J. E. Davidson & R. J. Sternberg (Eds.). *The psychology of problem solving*. Cambridge: Cambridge University Press.
- Rau, W., & Heyl, B. S. (1990). Humanizing the college classroom: Collaborative learning and social organization among students. *Teaching Sociology*, 18(2), 141-155.
- Slavin, R. (1986). *Using student team learning (3rd 3d.)*. Baltimore, MD: The John Hopkins University, Center for Research on Elementary and Middle School.
- Slavin, R. (1995). *Cooperative learning: Theory, research, and practice (2nd ed.)*. Needham Heights, MA: Allyn & Bacon.
- Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of educational research*, 69(1), 21-51.
- Tsay, M., & Brady, M. (2010). A case study of cooperative learning and communication pedagogy: does working in teams make a difference? *Journal of the Scholarship of Teaching and Learning*, 10(2), 78-89.
- Tuckman, B. W. (1965). Developmental sequence in small groups. *Psychological Bulletin*, 63(6), 384-399. doi:10.1037/h0022100