Authors
Dr. Sophia Scott
Ms. Belinda McMurry

Success of Team Problem-solving Constructed with Problem-solving Approach

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APPLIED PAPER ≡ PEDAGOGICAL PAPERS

Dr. Sophia Scott is Associate Dean for the College of Science, Technology and Agriculture and Professor in the Department of Polytechnic Studies at Southeast Missouri State University. She earned her PhD in Technology Management in 2004, Master of Industrial Management in 1998, and Bachelor of Science in Business Administration in 1996. She teaches courses in knowledge management, technology research, supervision and project management. Her research interests include high performance teams, leadership, ethics, experiential learning and project management.

Ms. Belinda McMurry is an instructor for the College of Science, Technology and Agriculture within the Department of Polytechnic Studies at Southeast Missouri State University. She earned her Master of Science degree in Technology and Occupational Education in 2003, as well as earning DESE teaching certification in journalism and technology education. She earned a Bachelor of Science degree in Mass Communication and Journalism, with a minor in writing in 2001. She has 10 years industrial experience in the areas of graphics, marketing, and technical writing. She teaches technical communication and industrial management courses, as well as technology & engineering education courses. Her research interests include educational teaming, experiential learning, and the increasing need for true technical communication courses within collegiate programs.

Preparing Undergraduates for Project Management on the Manufacturing Shop Floor

Dr. Sophia Scott and Ms. Belinda McMurry

ABSTRACT

Today more than ever, technology organizations seek employees who can work in teams to solve complex problems and use different approaches in solving these problems. Research has shown that all teams experience some degree of conflict, but greater conflict occurs within team members who possess extreme differences in problem-solving approaches (Kirton, 2000). The purpose of this study was to investigate team problem-solving success with teams constructed according to their approach to problem-solving. The Adaption-Innovation at Work (AI-W) inventory was used to assess problem-solving approach and a Hollow Square Puzzle was used to measure team problem-solving success. Of the 87 teams involved in the study, 37 (43%) of the teams solved the puzzle and 50 (57%) of the teams did not solve the puzzle. The results indicate that there was no difference in performance between similar and different teams. The researchers observed that the team members behaved according to their approach, which may have caused conflict, resulting in decreased problem-solving success.

INTRODUCTION

With changes in organizational structures, innovation, and increased workforce diversity, universities are tasked with preparing students to meet the global challenges in this complex work environment. Organizations look for employees who can work in teams to solve multifaceted problems. These problems call for different problem-solving approaches (Kirton, 2000). Hung (2013) and Ranieri (2004) agreed that students should move from factual knowledge to include problem-solving approaches while working in teams. Furthermore, Jozwiak (2004) affirmed that students need skills beyond technical training including working in teams, communicating, listening, paying attention to detail, and solving problems. Unfortunately, organizations take the time to compose teams with the right mix of technical skills, without regard to how individuals approach problems (McClough & Rogelberg, 2003). Many current models of problem-solving do not address approaches to solving problems and do not account for the diversity of teams (Jozwaik, 2004 & Kirton, 2000).

STATEMENT OF THE PROBLEM

Kirton (2000) found that all teams experience some degree of conflict, but greater conflict occurs within teams with extreme differences in how the individuals on the team approach the problem. Understanding these problem-solving approaches help students deal with conflict and cope within teams, which can be transferred to the work environment (Buffinton, Jablokow, & Martin, 2002). These coping skills lead to students appreciating differences in approaches. Managing these approaches, which can lead to conflict in teams, could mean the difference between success and failure. Aritzeta, Ayestaran, and Swailes (2005) found that teams acted according to their problem-solving approach and conflict increased with large differences in approaches. They found a positive correlation between problem-solving approach and cooperation in the teams with similar approaches. For example, one individual on a team may approach the solution to a problem that is specific and detailed, while another individual on the team may approach a solution that is abstract and innovative. These different approaches can cause conflict in the teams. Teams with large differences tend to have greater conflict in the team and teams with smaller differences tend to have less conflict (Summers, Sweeney & Wolk, 2000).

PURPOSE OF THE STUDY

The purpose of this study was to investigate problem-solving success of similar and different teams with teams constructed according to their approach to problem-solving. The study consisted of technology management students in the Department of Polytechnic Studies at a Midwestern university. The following questions were asked:

1. What is the problem-solving approach of technology management students?

2. Do teams with similar problem-solving approaches have more success in problem-solving than teams with different approaches?

BACKGROUND LITERATURE

Oladiran, Uziak, Eisenberg and Scheffer (2011) found that teamwork enhances quality decision-making and increases productivity. Diversity in teams typically yields the best solutions, especially if the team members can overcome team conflict (Sim & Wright, 2002). A successful team consists of a combination of individuals working together to solve a problem with the ability to decrease conflict. Differences in approaches to problem-solving can determine successful interactions in resolving conflicts in teams. Kirton (2000) found that effective teams require team members who can approach problems in different ways. In the workplace, many of these teams are formed without consideration of different approaches in solving problems (Buffinton, Jablokow, & Martin, 2002; Jozwiak, 2004; Kirton, 2000).

McClough and Rogelberg (2003) acknowledged that team members who approach problems in the same manner may have little team conflict, but also may not produce the best solutions. Additionally, Richards (2003) acknowledged that team member's knowledge and expertise may not be enough to reach the optimal solution to problems. These optimal solutions require different abilities and approaches. Because some individual team members search for solutions that adhere to the current organizational paradigm and other team members search for solutions to change the paradigm, the differing approaches impact the dynamics of the team, causing conflict. The right ability with the wrong approach could result in ineffective team performance. Kirton (2000)

found that small differences in team members' approaches resulted in minimal conflict, while great differences in approaches resulted in major conflict. All conflicts caused the team members to decrease in their overall performance.

Buffinton, Jablokow, and Martin (2002) found that project teams benefited from understanding and appreciating different problem-solving approaches. Stoyanov and Kirschner (2007) also emphasized the importance of problem-solving approaches in problem solutions. Kirton (2000) specified that there is a difference in the ability to solve a problem and the approach that an individual uses to solve the problem. Ability and approach are separate and do not relate to each other. For example, individuals can have the same ability, but approach the problem in a different way. Skinner and Drake (2003) looked at the achievement of students using Mehta's Achievement Motivation Inventory (AMI), Kirton's A-I approach, and academic performance. They found no relationship between motivation, approach, and academic performance.

ADAPTION-INNOVATION THEORY

Kirton (2000) discovered through a management initiative study that individuals have a preferred behavior he called thinking style or approach. This study was the starting point for creating the Adaption-Innovation (A-I) theory. He observed differences in the approach that individuals used to manage change in order to solve problems. He found that people work well together when their approaches match. According to the A-I theory, individuals have a preference for their approach that is not related to ability. Problem-solving approaches are consistent ways individuals approach new ideas, manage change, and respond effectively to complex challenges.

ADAPTION-INNOVATION IN TERMS

Kirton (1999) emphasized that individuals demonstrate characteristics on how they approach problems which allow them to perform individually and in a team environment. These characteristics of behavior can be placed on a continuum of high adaptors to high innovators. Adaptors tend to be disciplined in their approach and search for solutions to problems within recognized paradigms. Innovators tend to tackle problems from different angles and seek solutions unique to modern patterns. Kirton (2000) observed that teams constructed with

individuals who share similar approaches tend to have minimal conflict. Moreover, he found that teams constructed with individuals with dissimilar approaches may have conflict, making it more difficult to solve problems. He established that the benefit to A-I theory is to understand oneself and others, in order to use each other's strengths to work in effective teams to solve complex problems. According to Kirton (2000), organizations need both adaptors and innovators.

Kirton's A-I theory (2000) describes individual team member's problem-solving approaches by placing individuals on a continuum ranging from high adaptors to high innovators. Adaptors and innovators each have a preferred way of approaching problem-solving in teams. Table 1 describes patterns of behaviors observed in different problem-solving approaches.

TABLE (1): PROBLEM-SOLVING APPROACHES OF ADAPTORS AND INNOVATORS	
Adaptors	*Innovators*
Characterized by precision, reliability, efficiency, discipline, and conformity.	Characterized by undisciplined approach, tackling the task from unsuspected angles.
Concerned with resolving problems within the current paradigm.	Searches for solutions to problems outside the current paradigm.
Seeks solutions to problems in tried and understood ways.	Seeks solutions that are unique and different.
Tends to see policies and procedures as rules to be followed.	Tends to see policies and procedures as guidelines.

Adapted with permission (Kirton, 2000, pp. 10-11).

METHODOLOGY

This study investigated the behavior of student teams constructed with differing problem-solving approaches. In addition, student teams were analyzed solving a problem through a puzzle activity.

DESIGN AND PARTICIPANTS

The study involved 505 students; 390 males (77%) and 115 females (23%). This breakdown in gender was expected because traditionally, there are more males in departments with engineering and technology majors. The participants in the study were students enrolled in technical classes in the Department of Polytechnic Studies at a Midwestern university. The students were enrolled in 22 selected classes: Fall of 2013, Spring of 2014, Fall of 2014, and Spring of 2015. The design was an experiment involving 87 teams.

INSTRUMENTS

The first instrument used was the Adaption-Innovation at Work (AI-W) to assess problem-solving approach. The AI-W inventory was created as an alternative to the expensive Kirton Adaption-Innovation Inventory and is non-proprietary with the reliability of .70 and is considered valid (Xu & Tuttle, 2012). The AI-W inventory contains a pair of 9 statements that ask participants to match themselves using a 9-point Likert scale. The inventory consists of two sets of statements which ask respondents to evaluate their ability to possess the quality consistently over a long period of time, by choosing the number closer to them on the 9-point scale. For example, a statement might read, "I do routine work for long periods…. I avoid painstaking attention to detail." Overall, scores can range from 9 to 81. Scores ranging from 9-45 were considered more adaptive in their approach. Scores ranging from 46-81 were considered more innovative in their approach. The mean score for the population of AI-W is 45.

The second instrument used was a Hollow Square Puzzle, a problem-solving activity used to measure team success (Pfeiffer & Jones, 1974, 32-40). The puzzle was chosen because there was no performance level or ability required and could be solved in teams. The puzzle contained sixteen pieces, assembled on a square with a "hollow center." The Hollow Square is a communication exercise used to observe team behavior when trying to solve the puzzle. Each team self-selected two sub-teams consisting of a planning sub-team and an implementing sub-team. The goal of the planning sub-team was to draft written instructions, using words only, for the implementing sub-team to complete the puzzle. The goal of the implementing sub-team was to complete the puzzle from the written instructions. The teams were separated during their planning and implementing phases. No communication, verbal or non-verbal, was allowed between the sub-teams.

PROCEDURE

The procedure for carrying out the research involved these steps:

1. Students were introduced to the objective of the study and asked to sign a consent form to participate.

2. Students completed the AI-W. The researchers collected the completed forms and formulated teams according to the scores.

3. In a subsequent class, the students participated in the Hollow Square Puzzle as part of the class. The researchers observed the behavior and documented the results of the team success. The teams were considered successful if they solved the puzzle with 100% accuracy in the timeframe given.

TEAM FORMULATION

Students were asked to complete the AI-W. These scores were calculated by the researchers. In each class, the scores were put in numerical order and separated by adaptive (scores from 9-45) and innovative (scores from 46-81). Since the average class size was 24-30 students, there were 4-5 teams per class. The researchers created similar teams by grouping together scores that were within 10 points of each other. There were similar adaptive teams and similar innovative teams. The researchers created different teams by mixing adaptive scores with innovative scores in which scores had at least an 11-point spread. Each team consisted of six members. The teams were then divided into sub-teams (a planning and an implementing sub-team) with three members each.

RESULTS AND DISCUSSION

The purpose of this study was to investigate problem-solving success of similar and different teams with teams constructed according to their approach to problem-solving.

Research question 1: *What is the problem-solving approach of technology management students?*

Of the 505 students who participated, 308 (61%) were more adaptive; 154 (30%) were more innovative; no score was taken for 43 (9%) of the students due to attendance (See figure 1).

FIGURE (1): PERCENT OF THE PROBLEM-SOLVING APPROACH OF TECHNOLOGY STUDENTS
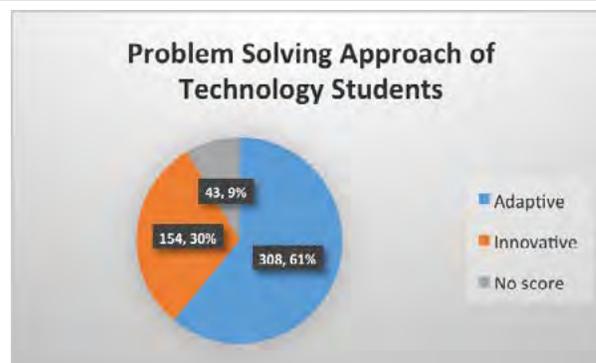
A majority of the students in the study were considered more adaptive by their scores. This finding was not surprising considering the nature of the discipline and the classes that were involved in the study. According to Kirton (2000), professions that are more engineering, production, or quality-oriented tended to be more adaptive in their scores. The students in this study were enrolled in technical classes in the Department of Polytechnic Studies.

Research Question 2: *Do teams with similar problem-solving approaches have more success in problem-solving than teams with different approaches?*

The students were enrolled in 22 selected classes in the Fall of 2013, Spring of 2014, Fall of 2014, and Spring of 2015. Teams were formulated according to their AI-W scores. Similar teams had scores within a 10-point spread, either adaptive or innovative. Different teams had scores with a point spread beyond 11 points and were a mix of adaptive and innovative. In the 22 selected classes, there were 87 teams involved in the study; 43 (49%) similar teams and 44 (51%) different teams. The formation of the teams can be seen in Table 2.

TABLE (2): FORMATION OF TEAMS		
Similar Teams		Different Teams
Adaptive	Innovative	Mixed (both Adaptive & Innovative)
Number (%)	Number (%)	Number (%)
22 (25%)	21 (24%)	44 (51%)

To help answer this research question, the researchers observed and documented the behavior of the student teams to verify if they behaved according to their problem-solving approach, as emphasized by Kirton (2000).

OBSERVATIONS OF SIMILAR TEAMS PLANNING THE PUZZLE

After introducing the purpose of the Hollow Square activity, the researchers and two graduate assistants observed how the teams interacted with each other. The researchers and graduate assistants knew, prior to the activity, the scores and types of teams used for the activity. Notes

were taken during the observations. It was observed by the researchers that the planning sub-team members, who were more adaptive in nature, acted according to the characteristics acknowledge by Kirton (2000). They were organized in their planning of the puzzle. They typically took turns adding the instructions and were very careful to provide a sequential structure. The more adaptive sub-teams often started with defining a structure, which mirrored A-I theory. The teams with members, who were more innovative, also behaved according to the characteristics described by Kirton (2000). They tended to throw-out ideas randomly as they were planning the puzzle instructions. They often started with debating how to organize the activity, instead of just starting to write the instructions. Additionally, it was observed that members who were more innovative in their approach tended to be louder in the planning room. It was also observed that the directions varied depending upon the approach taken. For example, more adaptive teams tended to have more detailed pages of instructions with precise descriptions of the pieces. More innovative teams, on the other hand, tended to have shorter instructions with vague descriptions of the puzzle pieces.

OBSERVATIONS OF DIFFERENT TEAMS PLANNING THE PUZZLE

It was observed by the researchers that the planning members of teams from different teams tended to act according to characteristics of Kirton's A-I theory (2000). They had a difficult time getting started because they were undisciplined in their approach. They would look at each other for someone to start the discussion of how they were going to approach the situation. There was often conflict on how specific the instructions needed to be written for the implementing sub-team. It was observed that as the team members were more adaptive, they tended to be quieter and wait their turn, while the members who were more innovative in their approach, tended to blurt out their ideas. Innovative members commented that the instructions were too detailed and the adaptive members commented that the instructions were too vague. These different approaches caused conflict in the teams during the planning phase.

SOLVING THE PUZZLE

There were 87 teams involved in the study; 43 similar teams and 44 different teams. It was hypothesized that 51% would solve and 49% would not solve the puzzle based on data of the percent of similar and different teams according to the AI-W inventory. In this study, 42% of the teams solved the puzzle and 57% of the teams did not solve the puzzle. See Table 3 for teams that solved the puzzle.

TABLE (3): NUMBER AND PERCENT OF TEAMS THAT SOLVED THE PUZZLE		
Similar Teams Solved		Different Teams Solved
Adaptive	Innovative	Mixed (both Adaptive & Innovative)
Number (%)	Number (%)	Number (%)
10 (11%)	9 (10%)	18 (21%)

The results indicated the equal success of similar teams (21%) and different teams (21%) in solving the puzzle. This result was not expected according to A-I theory, where there should have been a higher percentage of success for the similar teams compared to the different teams.   See Table 4 for teams that did not solve the puzzle.

TABLE (4): NUMBER AND PERCENT OF TEAMS THAT DID NOT SOLVE THE PUZZLE		
Similar Teams Not Solved		Different Teams Not Solved
Adaptive	Innovative	Mixed (both Adaptive & Innovative)
Number (%)	Number (%)	Number (%)
12 (14%)	12 (14%)	26 (30%)

The percentage of the different teams (30%) that did not solve the puzzle was slightly higher than the similar teams (28%). This result was expected as A-I theory recognizes that different teams typically do not solve problems at a greater rate than similar teams because of conflict.

OBSERVATIONS OF SIMILAR TEAMS IMPLEMENTING THE PUZZLE

It was observed by the researchers that similar teams who were more adaptive in their approach acted as expected according to Kirton (2000). They systematically read through the instructions first, then went through each step in the order presented, often marking-off the step as they

completed it. These more adaptive teams wasted no time getting started on the task. They were efficient in their approach which is consistent with A-I theory. The more innovative teams started with debating on how to start the tasks, behaving according to characteristics identified by Kirton (2000). These innovative team members tended to skim the instructions instead of reading them step-by-step. Many of the more innovative teams would choose a place on the puzzle square to start and then look at the instructions from that starting point. Again, it was observed that more adaptive teams were quieter and more innovative teams were louder.

OBSERVATIONS OF DIFFERENT TEAMS IMPLEMENTING THE PUZZLE

It was observed by the researchers that the different teams behaved according to A-I theory. These teams often started by debating on how to complete the puzzle. The researchers believe it was differences in their approaches that often irritated the more adaptive team members who wanted to start on the task by starting with the first step, while the most innovative members wanted to decide a process first. It was interesting to watch them struggle with the conflict of varying approaches. Some of the team members opted to sit back and observe and only if the step did not work, they would chime in.

SIGNIFICANCE OF THE STUDY

The significance of the study is that it can show awareness of conflict that can arise in teams as a result of different approaches. This awareness of A-I theory can be a tool to create an understanding of different approaches to problems. Teams can benefit from both approaches (adaptive and innovative) on a team, provided that conflict can be resolved. The results indicated that formation of teams, according to approach to problem-solving, did not influence team success. In this experiment, there was no difference in similar teams compared to different teams; however, it was observed that individuals acted according to their problem-solving approach. For example, similar teams typically have reduced conflict, but it was observed that teams were either too descriptive or not descriptive enough in writing their instructions. In other words, they behaved too much like their scores. This data suggest that when formulating teams according to problem-solving approach, this study differs from previous studies and therefore cannot be generalized to the

general population. This study did not validate that different teams would have trouble resolving conflict and decrease in success or that similar teams would have reduced conflict and increase in success in problem-solving. One possible reason for this study having differing results, might be that the time restriction could have caused additional conflict beyond their approach.

Overall, the solving of the puzzle became a competition to the students. After the activity, teams who did not solve the puzzle wanted to know the solution and would sit down with their sub-teams and try to figure out what went wrong in the instructions. The researchers found that in every class, there was a least one team who chose to cheat, even though points were not assigned for solving the puzzle. These teams were excluded from the research results. This may have also accounted for the fluctuations in team success.

CONCLUSIONS AND RECOMMENDATIONS

The research indicated that formation of teams according to problem-solving approach may not influence success in problem-solving, but it was observed that individuals behave according to their problem-solving approaches. This research can help educators and industry personnel to understand that conflict can occur with different approaches. The implications of this research are important to both educators and industry personnel. For educators, understanding problem-solving approaches may be helpful when making team assignments. For industry personnel, the practical implications reside in that organizations rely on teams to overcome conflict to solve problems. This study was limited by the researchers selecting the teams and the time-frame of the activities. Additionally, the students were not aware of their or their team member's problem-solving approach and were not taught how to resolve conflict in teams. This research was also limited by the geographical location and convenience of the population studied. The researchers suggest that future researchers should dedicate time to teaching teams about their problem-solving approach and how to overcome conflict in teams. This study should be expanded to include having the sub-teams pre-selected instead of self-selection. The focus should not be on the differences among adaptors and innovators, but on helping members understand their differences to reduce conflict. Adding conflict resolution would increase the value of the study. Future researchers should concentrate on formulating teams according to problem-solving approach and adding conflict resolution teaching or training to team problem solving.

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