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By Dr. Sophia Scott

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Dr. Sophia Scott is an Assistant Professor in the Department of Industrial and Engineering Technology at Southeast Missouri State University. She currently teaches courses in technical communication, supervision and project management. Dr. Scott received her Ph.D. in Technology Management from Indiana State University. Her research interests include high performance teams, leadership, ethics, experiential learning and project management.

Team Performance and the Problem-Solving Approach

By Dr. Sophia Scott

Abstract

The global landscape in the industrial environment requires teams of individuals who can solve multifaceted technical problems. Many organizations focus on providing team members with the tools and techniques used in solving such problems. However, one overlooked factor of team success is approach. Individuals with similar abilities approach problems in different ways. The right problem-solving ability with the wrong problem-solving approach could translate into ineffective team performance. There has been a plethora of research on the areas of team dynamics and problem-solving, but little research on the connection between team performance and problem-solving approach. The purpose of this study was to determine the effect of problem-solving approach on team performance. By studying teams in industrial and engineering education, this investigator sought to determine if teams whose members use similar approaches perform differently from teams whose members use dissimilar approaches. The Kirton Adaption-Innovation Inventory was used to assess problem-solving approach, and a Hollow Square Puzzle was used to measure team performance. The results indicated that, overall, 65% of the project teams solved the puzzle. Teams whose members had similar problem-solving approaches solved the puzzle 80% of the time, therefore performing better in the team environment. The results also showed that understanding your or your team member's approach to problem-solving does not influence team performance. The forming of teams according to problem-solving approach was the most significant indicator of team success.

Introduction

The industrial environment requires teams of individuals who can solve

multifaceted technical problems. Industry also needs employees who are able to participate in problem-solving teams. Terms for formal problem-solving teams used in industry include quality circles, task forces, and total quality teams. Universities that offer technical education understand that turning out graduates who can effectively solve problems in a team environment is essential. Accreditation requirements (NAIT, 2007 & ABET, 2007) are a driving force for universities to produce students who can solve industrial problems and work effectively in teams.

Organizations take great care in forming the right combination of individuals to create the best teams (McClough & Rogelberg, 2003) without regard to how individual team members approach problems. Industrial organizations invest billions of dollars in training, hoping for a return on their investment (Galvin, 2003). Kirton (1999) found that often in team training, individuals learn to use problem-solving tools and techniques to solve the problem. The focus of the training is on increasing an individual team member's ability. Kirton (1976) asserted that problem-solving ability and problem-solving approach are separate. Richards (2003) acknowledged that a team member's knowledge and expertise is not enough for a team to obtain the desired results; individual approaches should also be considered.

Individuals with similar abilities may approach problems in different ways that have a direct effect on team performance (Isaksen, Dorval, & Treffinger, 1994). Kirton (1976) observed differences in the ways in which individuals approached problems. These differences produced distinct patterns of behavior found in the team environment. Problem-solving differences can be identified using a simple instru-

ment, the Kirton Adaption-Innovation Inventory (KAI), developed in 1976. There has been a plethora of research on the areas of team dynamics and problem-solving (Hammerschmidt, 1996; Hueftle, 1992; Roman, 2001; Solomon, 1990), but little research on team performance and problem-solving approach. The purpose of this study is to determine if differences in problem-solving approaches affect team performance.

Statement of the Problem

Richards (2003) believed that effective teams require individuals who use and value different approaches when solving problems. Many technical teams jump into the problem-solving process and ignore the approach that individuals prefer in solving problems. Teams that approach problems in a similar manner have relatively small amounts of tension, but may not produce the best solution (McClough & Rogelberg, 2003). Most organizations teach employees how to use problem-solving tools and techniques to make decisions, but fail to address the nature of the problem to be solved or the various approaches to the problem. One individual may search for a solution to a problem that will have minimal impact on the organization, while another individual may seek a solution to shake the organization (Summers, Sweeney & Wolk, 2000). The different approaches will impact the success of the team in reaching a final solution. In order to investigate the impact of problem-solving approaches on team performance, 240 engineering and technology students were introduced to Kirton’s Adaption-Innovation (A-I) theory and asked to complete a puzzle in teams.

Purpose of the Study

Organizations are made up of individuals who are different in terms of knowledge, skills, abilities, and approaches. The right problem-solving ability with the wrong problem-solving approach could translate into ineffective team performance (Isaksen, Dorval, & Treffinger, 1994). A-I theory asserts that large differences in problem-solving approach can result in teams being unsuccessful

in solving problems (Kirton, 1999). This study investigated student teams in engineering and technical fields that were formed according to similar and dissimilar problem-solving approaches and asked to solve a puzzle. The following questions were investigated:

1. Do teams whose members have similar problem-solving approaches perform differently from teams whose members have dissimilar approaches?
2. Does knowing one’s own and other team members’ problem-solving approach affect team performance?

Theoretical Foundation

Technical teams are made up of diverse individuals with different skills and abilities. A majority of training programs focus on teaching the tools of problem-solving and ignore the individual approaches (similar to personality) to solving problems. This study relied heavily on Kirton’s Adaption-Innovation theory. According to A-I theory (Kirton, 1979), individuals have a preference in how they approach problem-solving, which is different from ability. These preferences or approaches can be identified by a simple psychological instrument called the Kirton Adaption-Innovation Inventory (KAI).

Problem-solving Approach

The KAI measures an individual’s problem-solving approach 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.

There is no preferred score, and KAI scores are believed to be non-pejorative, with the scoring direction considered irrelevant to success in problem-solving. The KAI score is not a dichotomy. There are no pure adaptors or innovators; however, individuals can be classified as more adaptive or less adaptive and more innovative or less innovative in their approach to solving problems. Individuals with KAI scores ranging from 32-95 are considered relatively adaptive, and individuals with scores ranging from 96-160 are considered relatively innovative in their approaches to solving problems. Scores need to be viewed in relation to others in the population or team. Table 2 (see page 4) shows the population distribution of KAI scores (Kirton, 1999, p. 39).

The value of A-I theory is that it offers fresh insight to explaining interpersonal conflict in teams (Kirton, 2000). Hammerschmidt (1996) agreed that problem-solving approach does make a difference in how people handle, solve, and communicate problems, and these differences influence team processes and performance. This study examined the performance of student teams that were formulated with small and large discrepancies in KAI scores.

Table 1. Problem-solving Approaches of Adaptors and Innovators

<i>Adaptors</i>	<i>Innovators</i>
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 problem 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).

Problem-solving Approach and Team Performance

Using KAI scores to assess problem-solving approach may shed some light on understanding conflict associated with teams. This conflict impacts the success of the team in providing consistent quality performance. Kirton (1999) found that within a team environment, small differences in KAI scores (10 or less) among team members resulted in minimal conflict. Intermediate differences in KAI scores (11-19 points) resulted in team members experiencing some conflict. Gaps of significant differences (20 or more points) in KAI scores seemed to cause increased conflict and friction among the team members. Successful team performance depends on several outside factors, including approach. Although important, ability, environment, and problem-solving techniques (including conflict resolution) were not considered within the scope of this study. Problem-solving approach was the independent variable used in this study.

Buffinton, Jablow, and Martin’s (2002) research on project teams indicated that the KAI can help with understanding and appreciating different approaches in team problem-solving. Hammerschmidt (1996) also reported that problem-solving approach does influence team performance. Because adaptors and innovators approached problem-solving differently, it was logical to assume that team members’ understanding of their problem-solving approaches could result in greater cohesion and possibly better problem-solving (Isaksen, Dorval, & Treffinger, 1994; Treffinger, Isaksen, & Dorval, 1997). Research indicates that if a class is divided into teams based on their KAI scores, the teams will perform according to their preferred problem-solving approach (Bobic, Davis, & Cunningham, 1999). Real collaboration requires that individual team members value each other’s different modes of thinking and approaches. Treffinger, Isaksen, and Dorval (1997) reported that teams improved effectiveness in the creative problem-solving process when group members were aware of

their problem-solving approach. In addition, Tullett (1996) found that balancing a team with different approaches will have a positive effect on team performance.

Methods

This study investigated student teams in engineering and technical fields that were formed according to similar and dissimilar problem-solving approaches and asked to solve a puzzle.

Subjects

The study involved 240 students who ranged in age from 18-49 years from a Midwestern university. The students were enrolled in twelve selected classes in the School of Polytechnic Studies in 2003-2005. The students completed the KAI and were placed in teams of six (N=40) according to their KAI scores. Although classes varied in size, only full teams were included in the results. There were 20 teams in the control group and 20 teams in the experimental group. Teams whose members had KAI scores within 15 points of each other were considered to have similar problem-solving approaches. Teams whose members had KAI scores that were greater than 15 points apart were considered dissimilar in problem-solving approach. Teams were successful if they solved the puzzle. Table 3 de-

scribes the KAI scores of the teams.

Instruments

The KAI was used to assess problem-solving approach. The KAI is a self-reporting 33-item questionnaire with scores ranging from 32 to 160. The measure of KAI has been used in many countries over the last two decades and is reported to be a consistent and reliable measure of problem-solving approach (Bobic, Davis, & Cunningham, 1999; Clapp, 1993; Kirton, 1999). Murdock, Isaksen, and Lauer (1993) indicated that the KAI was stable and has internal consistency. The KAI is one of the most highly validated instruments available. The reliability of the KAI has been documented (Blissett & McGrath, 1996; Sanfilippo, 1992) and the KAI was deemed an appropriate instrument for this research. The researcher attended an intense certification training workshop facilitated by Dr. Kirton and was certified to administer the KAI. The KAI forms were distributed to the students the class period before the puzzle was introduced. The researcher introduced the purpose of the study to the students and asked students to sign a consent form. Instructions were given and the KAI handed to each individual student.

Table 2. Population Distribution of KAI Scores

Adaptors		Innovators
80-95	Mild	96-110
65-79	Medium	111-124
50-64	High	125-139
49 or less	Very high	140 or more

Table 3. KAI Scores of Project teams

Team	Mean	Standard Deviation
Experimental Similar Approach (n=10)	97	7.22
Experimental Dissimilar Approach (n=10)	97	20.56
Control Similar Approach (n=10)	96	6.57
Control Dissimilar Approach (n=10)	96	17.55

Hollow Square Puzzle

A Hollow Square Puzzle was used to measure team performance (Pfeiffer & Jones, 1974, pp. 32-40). The Hollow Square was chosen because it was a puzzle that required no previous knowledge and was solved in teams. The Hollow Square puzzle contained 16 pieces and formed a square with a hollow center. The basis of this investigation was the belief that technical teams that understood their problem-solving approach would perform differently from teams without knowledge of their problem-solving approach. It was also the belief of the researcher that teams formulated with small KAI score differences would perform differently from teams with large KAI score differences. Teams were successful if they solved the puzzle in the prescribed timeframe. The independent variable was the presence or absence of KAI scores and a lesson on KAI theory. The control group (n=20) received no lesson, and the experimental group (n=20) received their scores and a lesson on KAI theory. The dependent variable used in this study was solving the Hollow Square puzzle.

Procedure

The following steps were involved in carrying out the research:

1. Students were introduced to the objectives of the study and asked to sign a consent form to participate.
2. The researcher introduced the KAI and gave directions for use to the

students in the selected classrooms. The researcher also collected the inventories and scored them all by hand.

3. Teams were formulated according to KAI total scores.
4. The experimental teams were given their KAI scores and a lesson on A-I theory and its impact on team performance. The control teams were not given their scores, and they did not receive a lesson on A-I theory.
5. The teams were given a short introduction to the goal of the puzzle and then given forty minutes as a team to solve the puzzle. Team performance was measured by teams that either solved the puzzle in the timeframe or failed to solve the puzzle.

Findings

This study investigated student teams in engineering and technical fields that were formed according to similar and dissimilar problem-solving approaches, with the focus on the impact of approach on performance.

Research question 1: Do teams whose members have similar problem-solving approaches perform differently from teams whose members have dissimilar approaches?

Overall, 65% of the project teams solved the puzzle in forty minutes. Of the 40 teams, 80% (16) of the teams with similar problem-solving ap-

proaches solved the puzzle compared to 50% (10) of the teams with dissimilar approaches. A t-test indicated that there was a significant difference (see table 4) in performance of teams with similar approaches compared to teams with dissimilar approaches.

The results indicated that teams whose members had similar problem-solving approaches performed better in the team environment. The results corroborated previous research (Hammer-schmidt, 1996) showing that individuals with similar approaches approached the puzzle in the same fashion, which in this experiment proved effective in solving the puzzle.

Research Question 2: Does knowing one's own and other team members' problem-solving approach affect team performance?

Of the 40 teams, 75% (15) of the teams in the experimental group solved the puzzle compared to 55% (11) of the teams in the control group. A t-test indicated that there was no significant difference (see table 5) in team performance with the experimental group compared to the control group.

The results indicated that team members' understanding of their own and their team members' approach to problem-solving does not influence team performance. The results con-

Table 4. T-test of similar and dissimilar approaches

	Mean	Variance	Observations	Pearson	p	T score	T critical
Similar Approaches	.8	.16842	20				
Dissimilar Approaches	.5	.26316	20				
				.5	.010163	2.85357	2.09302

*p , .05, two-tailed.

Table 5. T-test of experimental and control teams

	Mean	Variance	Observations	Pearson	p	T score	T critical
Experimental teams	.75	.19737	20				
Control teams	.55	.26053	20				
				.5	.21411	1.28537	2.09302

*p,.05, two-tailed.

tradicted previous research (Isaksen, Dorval, & Treffinger, 1994; Treffinger, Isaksen, & Dorval, 1997) suggesting that understanding problem-solving approach translates into increased team performance.

The teams with highest performance (90%) were teams in the experimental group whose members were most similar in their approach. Next in terms of performance (70%) were teams in the control group whose members were similar in their approach. Sixty percent of the teams in the experimental groups with dissimilar approaches solved the puzzle. The teams with the lowest success in solving the puzzle (40%) were teams in the control group whose members were dissimilar in their approach. The research shows that the formation of the teams according to problem-solving approach had the greatest impact on team performance.

Discussion & Implications

The data collected suggest that when forming teams, the right mix of problem-solving approaches should be considered. In this research, the forming of teams according to approach was the strongest indicator of team success. This study validated research suggesting that problem-solving approach does have an impact on team performance, but team members' knowledge of their different approaches does not necessarily translate into improved team performance. A limitation of this study was the short time in teaching A-I theory. The results may have been different had more time been devoted to the A-I theory. This research examined project teams of future engineers and industrial managers, and the findings of this research can contribute to team-driven work environments. 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. The focus should not be on the differences among adaptors and innovators, but on helping members understand their differences. Although this study was performed in

an educational setting, the researcher expects similar behaviors in industrial work environments. In industry, managers creating teams would be well advised to consider the team members' problem-solving approaches. The practical implications of this research lie in the fact that teams are necessary in many industrial organizations. Given the importance of team composition on team performance, an understanding of the preferences of individuals in problem-solving approach should be considered. This study was not able to establish if teams would perform better if kept intact for long periods of time. Further research needs to be conducted to examine the relationship of problem-solving approach over time with intact and non-intact teams in the industrial setting.

Summary and Conclusions

The premise of this study was that individuals differ in their approaches to solving problems. The results showed that there was a significant difference in the performance of teams whose members had similar approaches compared to teams whose members had dissimilar approaches. The results also indicated that there was no significant difference in performance of teams that understood their problem-solving approach. The most successful teams were teams in the experimental group whose members were similar in their approach and knew this, while the least successful teams were teams in the control group whose members were dissimilar in approach and did not know it. In conclusion, the need for members to understand problem-solving approach could not be established by this study. It is recommended that further research be done on intact teams and the study be duplicated on a larger scale in an industrial setting.

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