Problem Solving Approach of Technology Students

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Abstract: *This research was undertaken to investigate the differences in problem solving approaches between technology majors and other majors within a university. It also examined if differences exist between male and female problem solving approaches of technology majors and other majors. The participants were 396 students enrolled in various classes at Southeast Missouri State University. The population consisted of 188 technology majors of which, 129 were males and 59 females. There were 208 other majors of which, 164 were males and 44 were females. The study used the Kirton Adaption-Innovation Inventory (KAI) to measure the students' problem solving approach. The KAI puts individuals on a continuum from highly adaptive to highly innovative. The findings revealed the technology majors mean scores (M=96.3) were slightly higher than the KAI's total population (M= 95). The other majors mean score was 96.5. There was no significant difference in the KAI scores of technology and other majors. There was also no significant difference found between male and female approaches between technology majors and other majors.*

I. Introduction

The very nature of change causes the work environment to be highly volatile and uncertain. To rise above the tide of uncertainty and remain competitive, organizations seek talented employees who can manage change and solve problems. Pendlebury, Grouard and Meston (1998) recognized that the rate of change is accelerating and there is a need for people to manage this change. Kirton, (1989, 1999, 2000) established that humans seek to manage change by solving problems. There is a distinction between ability and the way in which the problems are solved. Unfortunately, much of the problem solving research concentrates on the ability to solve a problem, rather than focusing on the way the problem is solved, the approach. Adaption-Innovation (A-I) theory is founded on the assumption that all people solve problems in different ways (Kirton, 2000). A-I theory states that individuals have a preference on how they approach problem solving. This problem solving approach places individuals on a continuum ranging from high adaptors to high innovators. Certain occupations, like engineering, tend to attract more adaptive individuals, but no prior studies were found that examined problem solving approach among certain industrial and engineering technology majors compared to other majors in the university. Do the more technical majors attract students with certain problem solving approaches? The purpose of this research is to determine if technology majors differ in their problem solving approach compared to other majors. This research seeks to answer the following questions:

1. Is there a difference between the problem solving approach of technology majors compared to the problem solving approach of other majors at Southeast Missouri State University?
2. Is there a difference in male and female problem solving approaches of technology majors compared to other majors at Southeast Missouri State University?

II. Problem Solving Approach

Early observations made by Kirton (2000) indicated that critical differences existed in the ways people approached problems that were not related to ability, but rather a deep-seated trait. These differences later became the foundation of A-I theory. He observed that differences in problem solving approach produced distinctive patterns of behaviors. The Kirton Adaption-Innovation Inventory (KAI) measures problem solving approach and puts individuals on a continuum from highly adaptive to highly innovative. Adaptors and innovators each have their own set of preferred characteristics. Table 1 describes characteristics of behaviors observed in different problem solving approaches.

Table 1 *Characteristics 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 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).

There is no preferred KAI score, and KAI scores are believed to be non-pejorative, with the scoring direction considered irrelevant to success in solving problems. 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. The population mean is 95. Scores need to be viewed in relation to others in the population. Table 2 shows the population distribution of KAI scores (Kirton, 1999, p. 39).

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

The value of A-I theory is that it offers fresh insight on how individuals approach and ultimately solve problems (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 problem solving.

III. Problem Style Approach in Occupations

Studies (Korth & Pettigrew, 1999; Sanfilippo, 1992; see also Isaksen, Dorval & Treffinger, 1994) using the KAI have concluded that certain occupations attract either adaptors or innovators (see Table 3).

Table 3 *Table of Occupational Differences*

Mean Score(s)	**Sample**	**From**
80-90	Branch Bank Managers, Civil Servants, Cost Accts, Plant Managers, Machine Superintendents, Production Managers, Accts. Supervisors, Maintenance Engineers, Programmers.	UK, US, Italy, Canada, Singapore, Australia, Slovakia
83	Apprentices (Tech. Engineers)	UK
91-92	Secretaries, Nurses	UK, US
93-97	Teachers	UK, US,
94-95	General Population	UK, US, Italy, France, Slovakia, Netherlands
95-96	Engineers, Military Officers	US
96-97	Managers generally, Engineers generally	UK, US, Italy, Canada, Singapore, Slovakia
101-103	R & D Managers	UK, US
104-110	Marketing, Finance, Planning Personnel, Fashion Buyers	UK, US, Italy, Canada, Singapore, South Africa

Reproduced with permission from the KAI Feedback Booklet (Kirton, 1999, p. 5).

Studies established that individuals with knowledge of KAI scores may be able to predict the selection of jobs within certain occupations (Kirton & Pender, 1982; McCarthy, 1993). For example, in the occupation of engineer, maintenance and production engineers tend to be more adaptive, while research and development engineers were apt to be more innovative. Of particular relevance to this study is the problem solving approach of students pursuing technology degrees with majors like manufacturing, engineering technology, computer technology, agriculture, agribusiness, industrial management, technical graphics, telecommunication, construction management, and industrial education. It is reasonable to assume that according to A-I theory, students majoring in technology should be more adaptive compared to other majors. One aim of this present study is to compare the mean KAI scores of a sample of technology majors to a sample of other majors. The occupations that were similar to technology majors (see Table 3) included plant and production managers, maintenance engineers, technical engineers and general engineering with a KAI range of 80-97. It should be noted that the mean population for engineers is 97 for males and 102 for females (Kirton, 1999).

IV. Methods

The subjects of the study were undergraduate students attending Southeast Missouri State University. The participants of the study consisted of 396 (293 male and 103 female) undergraduate students enrolled in the following classes: Science, Technology & Society; World Food & Society; Technical Communication; Architecture Draft & Design; Solid Modeling; and Technology Education in the years 2004-2008 (see Table 4). These particular courses were chosen based on their appeal to a variety of majors across campus and willingness of instructors to allow the research to be performed in their classes. The participants ranged in age from 18 years to 50 years. Permission for conducting research activities involving human subjects was obtained from Southeast Missouri State University Human Subjects Committee. Participation was voluntary and the participants were asked to sign a consent form that provided the intent of the study.

Table 4 *Participant Demographics*

Demographic Characteristics	**Technology Majors**	**Other Majors**	**Total**
Population			
N	188	208	396
Percent	47%	53%	
Male			
N	129	164	293
Percent	69%	79%	
Female			
N	59	44	103
Percent	31%	21%	

Instrument

The KAI is a self-reporting 32 item inventory developed to assess problem solving style. The respondents rated how they would present themselves consistently over a long period of time. The statements ranged from very hard to very easy. The measure of KAI has been used in many countries over the last two decades and is a consistent and reliable measure of problem solving style (Bobic, Davis, & Cunnningham, 1999). The reliability of the KAI (Wegsten, 1989) has been documented and is deemed an appropriate measure for this research.

V. Results

The purpose of this research was to determine if technology majors differ in their problem solving approach compared to other majors.

Research Question 1

Is there a difference between the problem solving approach of technology majors compared to the problem solving approach of other majors at Southeast Missouri State University?

The researcher found no prior studies examining technology majors compared to other majors. Prior research suggests that technology majors should be more adaptive or mildly innovative with KAI ranging from 80-97. Table 5 contains the description of majors and KAI scores.

Table 5 *Description of Major and KAI Score*

Major	**Adaptive**	**Innovative**
Technology Majors		
N= 188 (47%)	N=90 (23%)	N=98 (24%)
KAI range=57-133	Range= 57-95	Range =96-133
KAI mean= 96.3		
Other Majors		
N= 208 (53%)	N=102 (26%)	N=106 (27%)
KAI range=53-142	Range=53-95	Range=96-142
KAI mean=96.5		
Total = 396	N=192 (48%)	N=204 (52%)

The data indicates that this sample was slightly more innovative (52%) than the total population. Technology majors mean KAI score (96.3) was slightly higher than the population mean of 95. Technology majors scored similarly (96.3) to the engineering population (97). The data follows Kirton's categorization of engineering occupation KAI means. This research found no significant difference in the mean KAI scores of technology majors compared to other majors at Southeast.

Research Question 2

Is there a difference in male and female problem solving approach of technology majors compared to other majors at Southeast Missouri State University?

Seventy-four percent of the population in this study was male and 26% was female. Research suggests that females in engineering type fields tend to be more innovative with a mean KAI score of 102. This study did not find this to be the case. Both male and female KAI scores ranged from 53-133. The mean score of both males and females was 96. The results of this particular study indicate that there is no difference in male and female problem solving approach of technology major and other majors. In addition, this study indicated that technology females were not as innovative (96) compared to (102) of female engineers in previous studies.

VI. Discussion and Conclusions

The participants in this study mirrored prior studies of engineering populations with the exception of female technology majors. The researcher expected the technology majors to be slightly more adaptive with a mean KAI score of 95 or less. This expectation was found to be incorrect. It was predicted that because females typically major in more creative fields within technology like graphics, telecommunications and education, their KAI scores would be slightly more innovative (above 96). Female technology majors had similar means of the technology population of males. It was surprising to find that female's technology majors had a similar KAI mean of 96 instead of a more innovative approach of 102. The results could have been skewed with more women entering into engineering fields. Female engineers may approach problems in similar ways as their male counterparts. The implications of this study substantiate that students may choose majors similar to how they choose occupations - based on their problem solving approach. Understanding problem solving approach may help students to understand their preference to select certain majors and occupations. Further study should be done on females in more specific majors in technology fields.

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