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A COMPARISON OF PERSONALITY TYPE & LEARNING STYLE OF ELEMENTARY EDUCATION MAJORS, MATH MAJORS, AND MATH PROFESSORS: CULTURES IN CONFLICT

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National concern exists regarding the math performance of women and minorities. At IWU, faculty and students have reported frustration and dissatisfaction with Math 105, Mathematics for Elementary Teachers, a class composed almost entirely of females. An examination of the Illinois Wesleyan experience might shed light on the national situation.

It was hypothesized that elementary education students would differ from math majors and professors on the Myers-Briggs Type Indicator (MBTI), a self-report instrument derived from Jung's theory of personality types. In addition, differences in learning style as determined by performance on the Productivity Environmental Preference Survey (PEPS) were expected. It was hypothesized that personality type and learning style of math majors would resemble those of math professors.

The elementary education junior class (n=20 females), upper-level math majors (n=21, 7 females and 14 males), and math professors (n=4, identity unknown, however, 5 of 6 IWU math faculty are male) were administered both instruments by the Director of the Career Center. ACT math scores for elementary education students in the study ranged from 17 to 34 (mean=24.65, median=24.5, mode=23.00) ACT math scores for math students in the study ranged from 25 to 33 (mean=29.84, median=31.00, mode=31.00 and 33.00).

No significant differences were found among the three groups on the PEPS for factors such as persistence, motivation, and structure. MBTI profiles of math students and math professors were alike but elementary education students differed dramatically. Statistically significant differences were found between elementary education and math students on the Thinking-Feeling scale ($z=2.94$, $p<.01$). The proportion of elementary education students whose preference on the T- F scale was Feeling (80%, n=16) differed significantly from that of math majors who preferred Feeling (33%, n=7). Differences were found between elementary education students and math faculty on the Sensing-Intuitive Scale ($z= 1.67$, $p<.1$). Fifty-five percent (n=11) of the elementary education students preferred intuitive cognitive processing as compared to 100% of the faculty (n=4). Significant differences between education students and math faculty were found on the Thinking-Feeling Scale ($z=2.4$, $p<.05$).

The education students' dominant type, Feeling, (40%, n=8) was the third auxiliary, the weakest type, for 50% of the participating math faculty (n=2). Conversely, Thinking, the dominant type for those math faculty, was the education students' third auxiliary. According to MBTI research, students often resist and take an emotionally defensive posture when teachers' dominant type challenges their third auxiliary. Students learn best in classes which utilize their dominant type and gradually strengthen the third auxiliary.

Chapter 1: Statement of the Problem and Rationale

National concern exists regarding the math performance of women and minorities. It is a common concern that the current educational system is not meeting girls' needs. Girls and boys enter school equal in measured ability, but years later, girls have fallen behind their male counterparts in key areas such as higher-level mathematics. A critical step in correcting the inequity is to adequately prepare those responsible for the education of children: the future teachers of America. Educational excellence in America's schools is dependent on educational equity.

Math 105, Math for Elementary Education, has been a source of frustration for math professors as well as elementary education majors at Illinois Wesleyan University, a small private undergraduate institution in the Midwest. Math for Elementary Education, which is composed almost entirely of females, is a course which examines number theory and other areas of mathematics underlying the content of elementary level mathematics. It has been a required course in the elementary teacher education program, and meets one of the two Illinois State Board of Education general education math requirements. As of 1991-92, elementary education students with a strong math background have been allowed to bypass this course into a Calculus sequence. This study was an attempt to discover the factors contributing to the chronic friction reported to exist between professors and students in this course. It is hoped that an examination of the Illinois Wesleyan experience might shed light on the national situation.

Elementary education students and mathematics professors each have theories which explain dissatisfaction with the course. Although students

sometimes blame the professor, this explanation is questionable since the professor of record has changed four times in the last four years. The faculty sometimes blame the elementary education students' interest in pedagogy and disinclination for mathematics. But this cannot be a complete explanation because many students in the course have successfully completed mathematics courses at the high school and college levels and have performed well in math on college entrance exams. Professor and student capabilities cannot of themselves account for course friction. One wonders if the elementary education students collectively inhabit a culture which is quite different from that of the university mathematics professor. Is it possible that psychological constructs, namely personality type and learning style, related to group orientation and gender difference help explain the conflict and contribute to math anxiety and math resistance of students?

This study investigated whether differences in learning style, which often determines teaching style, and personality type could explain miscommunication, tension, and resistance in the Math 105 course. Learning style and personality type were assessed using the Productivity Environmental Preference Survey and the Myers-Briggs Type Indicator, respectively. The learning style and personality type of mathematics majors from the same institution was also assessed. Math majors were included as a comparison group because similar friction is not reported between math majors and math professors. The performance of these three groups were compared, in order to test the following hypotheses:

1. IWU Elementary Education students will show significant differences on the Myers-Briggs Type Indicator and on the Productivity Environmental Preference Survey from math professors within the same institution.

2. Math majors will not differ significantly in personality type and learning style from math professors.

Chapter 2 - A Review of the Literature

The influence of gender differences in mathematics, mismatched teaching and learning styles, and conflicting personality types were studied to determine their effect on the reported friction in the Math 105 course.

Females and Mathematics

A recent report of the American Association of University Women Educational Foundation (1992) stated that there are many differences in academic performance between males and females, especially in the areas of math and science. The AAUW report stated that differences between boys and girls in math test achievement are small and declining. Yet in high school, girls are less likely to take advanced mathematics courses. "Even girls who are highly competent in math are less likely to pursue scientific or technological careers than their male classmates" (p. 4).

According to Tobias (1978), the absence of females in math and science careers may be a reflection of anxiety experienced by females in math and science. A person who experiences math anxiety may suffer from emotional or physical discomfort when faced with any mathematical task (Tobias, 1981). Tobias (1978) stated that math anxiety is especially problematic for females because performance in math and science has generally been considered in the male domain, and females may be socialized to believe themselves incompetent in mathematics. A definite correlation between high math anxiety and low math achievement has been documented (Frary & Ling,1983; Suinn & Edwards,1982). Females and feminine-typed persons reported

higher math anxiety scores than did males or masculine-typed persons (Biaggo & Neilsen, 1976; Gall,1969; Sarason, 1963).

Learning Styles

In addition to the effects of gender on mathematics achievement and attitudes, the influence of mismatched teaching and learning styles was also studied to determine its effect on the friction reported in the Math 105 course. Keefe (1982) defined learning styles as "cognitive, affective, and physiological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment." Learning style theorists contend that the way a person learns involves preferences for teaching approach, socialization, movement, lighting, and the use of certain senses. Relationships between learning style and other characteristics, such as teaching style, achievement and attitudes, student age, and student gender have been widely studied. According to research carried out by Barbe & Milone (1980), Cornett (1983) and Witkin (1976), teaching style is determined by one's learning style preference. Teachers teach the way that they learn best unless a conscious effort is made to do otherwise.

Many studies have shown the influence of learning style on student achievement and attitudes. Matching the teacher's learning style to that of the student has resulted in increased achievement and improved attitudes toward instruction (Abraham,1965; Canfield,1980; Dunn,1982; Witkin,1976). Still, other studies have shown that there is no association between matching learning style and academic improvements of any kind (Adams & McLeod,1979; Ballard,1980; Fox,1984). This conflicting data indicates that

uncertainty exists over specific conditions needed to improve achievement by matching learning style.

According to Cornett (1983), one's learning style changes with age and experience. This finding was further substantiated by the work of Ommen, Brainhard, & Canfield (1979), who found dramatic learning style differences between younger and older students. According to a publication of the Illinois State Board of Education written by Banks (1991), no studies have provided conclusive evidence that gender influences learning style.

Personality Type

In addition to the above mentioned gender differences and mismatched teaching and learning styles, the effect of conflicting personality types was considered as a possible explanation of miscommunication and tension in the Math 105 course. Psychological type, according to C. G. Jung (1921), represents the way that people prefer to perceive and judge the information that is encountered during everyday life. Perception includes " information gathering, the seeking of sensation or of inspiration, and the selection of the stimulus to be attended to" (Myers & McCaulley, 1985, p.12). Judgment includes "decision making, evaluation, choice, and the selection of a response after perceiving the stimulus" (Myers & McCaulley, 1985, p.12). The essence of Jung's theory is the belief that everyone uses four basic mental processes: Sensing (S), Intuition (N), Thinking (T), and Feeling (F). These four mental processes represent an individual's orientation to consciousness. Jung defined a mental process as "a particular form of psychic activity that remains the same in principle under varying conditions" (Jung, 1921, p.436).

Mental processes were reduced to only four functions by Jung who concluded "I distinguish these functions from one another because they cannot be related or reduced to one another" (Jung, 1921, p. 437).

The typology that Jung developed to characterize differences in mental processing consists of two attitudes, two perceptive functions, two judgment functions, and two orientation functions. The orientation function was developed by Isabel Myers and Katherine Briggs who argued that the importance of such a function was implicit in Jung's work.

The following definitions of each of the functions were taken from *Manual: A guide to the Development and Use of the Myers-Briggs Type Indicator* by Briggs & McCaulley (1985).

Attitudes: *Extraversion - Introversion*

Extraversion and Introversion, as defined by Jung, are regarded as mutually complementary attitudes whose differences "generate the tension that both the individual and society need for maintenance of life" (Jung, 1921, p.160). Extraverts are oriented to the outer world; thus they tend to focus their perception on people and objects. Introverts are oriented toward the inner world; thus they tend to focus their perception on concepts and ideas.

Perceptive Function: *Sensing - Intuition*

This scale is designed to reflect a person's preference between two opposite ways of perceiving; one may rely primarily on the process of sensing, which reports observable facts through one or more of the five senses; or one may rely more on the less obvious process of intuition, which reports meanings,

relationships, and possibilities that have been worked out beyond the reach of the conscious mind.

Judgment Function: *Thinking - Feeling*

This scale is designed to reflect a person's preference between two contrasting ways of judgment. A person may rely primarily on thinking to decide impersonally on the basis of logical consequences, or a person may rely on feeling to decide on the basis of personal or social values.

Orientation Function: *Judgment - Perception*

This scale is designed to describe the process a person uses in dealing with the outer world. A person who prefers judgment has reported a preference for using a judgment process, either Thinking or Feeling, for dealing with the outer world. A person who prefers perception has reported a preference for using a perceptive process, either Sensing or Intuition, for dealing with the outer world.

According to theory of personality type, one pole of each scale is preferred over the other. Jung emphasizes the fact that poles on these scales are not superior or inferior to their opposite; each extreme has strengths as well as weaknesses. Preference on one scale is entirely independent of preferences on other scales. By determining a preference on each of the four scales, a possibility of sixteen combinations exists (See Table 1), which determines one's individual personality type.

Table 1
Sixteen Possible Combinations in Jung's Personality Typology

ISTJ	ISFJ	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFJ	ENFJ	ENTJ

E=Extraversion, I=Introversion, S=Sensing, N=Intuition, T=Thinking, F=Feeling, J=Judgment, P=Perceiving

In psychological typology, Jung postulated that each individual possesses all four mental processes (Sensing, Intuition, Thinking, and Feeling) in some degree. The capacity to control each function depends upon its relative position in the hierarchy of a particular individual. Each individual has a dominant function, the most preferred function, which is chosen from the four mental processes, that is used with the most confidence and ability. In turn, each individual also has a third auxiliary function, a least preferred function, which is always the opposite dominant type, that is most problematic and frustrating when called to use.

Psychological Type affects not only what people attend to in any given situation, but also how they draw conclusions about what they perceive. According to Huelsman (1983), preferences in personality type are seen in the way that students prefer to learn and in the way that teachers prefer to teach. In the studies conducted by Barger & Hoover (1984), many educational implications arise when considering the personality types of teachers and students. Selected implications of Barger & Hoover are as follows:

1. Differences in psychological type between teachers and students can lead teachers to misunderstand the learning styles of students.
2. Conflicts in type can lead to difficulties in interpersonal communications among students and between students and teachers.
3. The first approach to students' learning problems should probably be through their dominant function.
4. Improvement in schooling may mean dealing with the third auxiliary as well as strengthening the dominant.

In addition to these educational implications, Barger & Hoover (1984) stated that teachers often challenge a student's third auxiliary during the course of instruction. When this occurs, the student, functioning in the third auxiliary, may react in a variety of ways, ranging from inattentiveness to open resistance. When forced to operate in the third auxiliary, the student often may take on an emotionally defensive posture. Conversely, if a student challenges a teachers third auxiliary, similar results occur.

Chapter 3 Research Design and Methodology

Hypotheses to be Tested

(1) IWU elementary education students would show significant differences on learning style, measured by the Productivity Environmental Preference Survey, from math professors.
(2) IWU elementary education students would show significant differences on personality type, measured by the Myers-Briggs Type Indicator, from math professors within the same institution.
(3) Math majors would not differ significantly in learning style from math professors.
(4) Math majors would not differ significantly in personality type from math professors.
(5) Elementary education students would differ significantly in learning style from math majors.
(6) Elementary education students would differ significantly in personality type from math majors.

Design

The personality type and learning style of elementary education students, math students, and math professors at Illinois Wesleyan University were determined using the Myers-Briggs Type Indicator and the Productivity Environmental Preference Survey, respectively. Results were analyzed using

a comparison of two binomial parameters to determine whether elementary education students, math students, and math professors tend to differ in preferred type. This resulted in a two-tailed test with alpha specified.

Subjects

Participants in the study were categorized into three distinct groups. The sample consisted of junior level elementary education majors, upper level math majors, and math faculty from Illinois Wesleyan University. Participation in the study was on a voluntary basis.

The elementary education group consisted of 20 females. Math ACT scores revealed a range of 17 - 34. The mean of the Math ACT scores was 24.65; the median was 24.5; and the mode was 23.00.

The math students consisted of 21 sophomores, juniors, and seniors. Among these 21, 14 were male and 7 were female. Math ACT scores revealed a range of 25 - 33. The mean of the Math ACT scores was 29.84; the median was 31.00; and the mode was 31.00 and 33.00.

Four math faculty volunteered to participate in the study. Gender is unknown due to confidentiality and anonymity, but 5 out of 6 faculty in the department are known to be male.

Instrumentation

The Productivity Environmental Preference Survey (PEPS) was used to determine the "conditions under which an individual will be most likely to

produce, achieve, create, problem solve, or learn" (Price, Dunn, & Dunn, 1991, p. 6). It is the adult version of the Learning Styles Inventory by Dunn & Dunn (1975), designed for use with children. This instrument identified how adults prefer to function in the following areas: a) immediate environment (sound, temperature, light, and design); b) emotionality (motivation, responsibility, persistence, and the need for either structure or flexibility); c) sociological needs (self-oriented, peer-oriented, authority-oriented, or several ways); and d) physical needs (perceptual preferences, time of day, intake and mobility). Individual responses are answered on a Likert Scale; strongly agree - 5 and strongly disagree - 1.

The validity of the PEPS is somewhat questionable as several research studies reported in the manual suffer from small sample sizes. The construct or predicative validity of the assessment is not addressed; only descriptive information is provided. The reliabilities reported seem to be in the acceptable ranges. It is reported, though, that only 68% of the reliabilities are equal to or greater than .60; seven factors have reliabilities greater than .80; but none reaches .90. The standardization sample is rather ill-defined as it is reported as 589 adults "from several states and from various academic and industrial settings" (Price, Dunn, & Dunn, 1991, p. 18). The PEPS is suggested for use as a counseling measure or as a component of a research program that included both environmental assessment and performance/productivity measures as outcome criteria.

The Myers-Briggs Type Indicator (MBTI) was used as a measure of personality type. The MBTI is a 166 - item forced choice instrument, based on Jung's theory of psychological type, that reports personality preferences on four scales. It is fundamental to Jung's theory that certain preferences on each scale are not superior to other preferences; each preference has both strengths

and weaknesses. The scales are intended to measure dominant perceptual-cognitive processes that are related to interpersonal and environmental orientation. The Extraversion - Introversion (E - I) scale measures the degree to which a person focuses on the outer world of people and the external environment versus the internal world of feelings and ideas. The Sensory - Intuition (S - N) scale measures the degree to which a person uses senses to perceive and acquire information versus using meanings, relationships, and possibilities that go beyond the information acquired through senses. The Thinking - Feeling (T - F) scale measures the degree to which a person uses logical-cognitive processes to make decisions or judgements versus the use of nonrational affective processes. The Judgment - Perception (J - P) Scale measures the extent to which a person attempts to order the world by generating rules versus the desire for a flexible and spontaneous approach. From these scales, dominant and auxiliary functions can be ascertained.

The validity of the MBTI is entirely dependent on the consumer's acceptance of the Jungian psychological typology that underscores the MBTI, which has a considerable body of evidence which supports the validity of the assessment. The reliability of the assessment has been established by the use of Split-Half reliability and Test-Retest reliability. The MBTI is suggested for use in the psychological and educational domains.

Procedure

Participants were informed about the nature of the study and that confidentiality would be maintained. Both assessments were administered on a number of instances to accommodate the participants' schedules. Test administration and anonymity of results were handled by Natalie Mahoney,

Director of the Career Center at Illinois Wesleyan University. Subjects were allowed one week to complete the assessments and Ms. Mahoney informed participants of individual results.

Chapter 4 Results and Conclusions

Results of the PEPS

Tables 2 and 3 contain information regarding the learning style preferences for the participants involved. Standard scores are determined by comparison to a random sample of 1000 subjects from the national data base who have taken the PEPS. The standard score ranges from 20 to 80 with a mean of 50 and a standard deviation of 10. For those who report a standard score of 60 or above, the presence of the variable serves to increase the productivity of a student; whereas for those who report a standard score of 40 or below, the presence of the variable hinders productivity.

Table 2

Percentages of Subjects Indicating a Preference For Environmental Stimuli *

PEPS Subscales	Elementary	Math Students	Math Faculty
1	15.00	66.67	75.00
noise level	n=3	n=14	n=3
2	10.00	14.29	0.00
light	n=2	n=3	n=0
3	10.00	9.52	0.00
temperature	n=2	n=2	n=0
4	15.00	4.76	0.00
formal design	n=3	n=1	n=0
5	5.00	4.76	0.00
motivation	n=1	n=1	n=0
6	5.00	19.05	0.00
persistent	n=1	n=4	n=0
7	20.00	19.05	0.00
responsible	n=4	n=4	n=0
8	50.00	42.86	0.00
structure	n=10	n=9	n=0
9	15.00	19.05	25.00
learning alone	n=3	n=4	n=1
10	25.00	33.33	50.00
authority figures	n=5	n=7	n=2
11	10.00	0.00	0.00
learn-several ways	n=2	n=0	n=0
12	10.00	14.29	25.00
auditory	n=2	n=3	n=1
13	5.00	9.52	0.00
visual	n=1	n=2	n=0
14	25.00	47.62	50.00
tactile	n=5	n=10	n=2
15	0.00	14.29	0.00
kinesthetic	n=0	n=3	n=0
16	35.00	61.90	0.00
requires intake	n=7	n=13	n=0
17	5.00	0.00	0.00
morning	n=1	n=0	n=0
18	5.00	4.76	0.00
late morning	n=1	n=1	n=0
19	45.00	47.62	50.00
afternoon	n=9	n=10	n=2
20	20.00	42.86	25.00
needs mobility	n=4	n=9	n=1

*as indicated by a standard score of 60 or greater

Table 3

Percentages of Subjects Indicating an Aversion to Environmental Stimuli *

PEPS Subscales	Elementary	Math Students	Math Faculty
1	40.00	9.52	0.00
noise level	n=8	n=2	n=0
2	15.00	9.52	50.00
light	n=3	n=2	n=2
3	20.00	14.29	25.00
temperature	n=4	n=3	n=1
4	15.00	23.81	0.00
formal design	n=3	n=5	n=0
5	15.00	14.29	0.00
motivation	n=3	n=3	n=0
6	10.00	9.52	25.00
persistent	n=2	n=2	n=1
7	25.00	19.05	50.00
responsible	n=5	n=4	n=2
8	10.00	0.00	0.00
structure	n=2	n=0	n=0
9	10.00	28.57	0.00
learning alone	n=2	n=6	n=0
10	10.00	4.76	0.00
authority figures	n=2	n=1	n=0
11	10.00	4.76	25.00
learn-several ways	n=2	n=1	n=1
12	20.00	9.52	0.00
auditory	n=4	n=2	n=0
13	20.00	9.52	25.00
visual	n=4	n=2	n=1
14	15.00	9.52	0.00
tactile	n=3	n=2	n=0
15	20.00	0.00	0.00
kinesthetic	n=4	n=0	n=0
16	10.00	0.00	0.00
requires intake	n=2	n=0	n=0
17	20.00	33.33	50.00
morning	n=4	n=7	n=2
18	30.00	38.10	25.00
late morning	n=6	n=8	n=1
19	5.00	9.52	0.00
afternoon	n=1	n=2	n=0
20	10.00	9.52	0.00
needs mobility	n=2	n=2	n=0

* as indicated by a standard score of 40 or below

Results of the MBTI

Table 4

Percentages of MBTI Subscale Preferences for Elementary Education Students, Math Majors, and Math Faculty

	Extra	Intro	Sens	Intu	Think	Feel	Judge	Perceive
Elem	60	40	45	55	20	80	70	30
	n=12	n=8	n=9	n=11	n=4	n=16	n=14	n=6
M. Maj	38	62	33	67	67	33	62	38
	n=8	n=13	n=7	n=14	n=14	n=7	n=13	n=8
M. Fac	25	75	0	100	75	25	50	50
	n=1	n=3	n=0	n=4	n=3	n=1	n=2	n=2

Elem=Elementary Education Majors, M. Maj=Math Majors, M. Fac=Math Faculty, Extra=Extravert, Intro=Introvert, Sens=Sensing, Intu=Intuitive, Think=Thinking, Feel=Feeling, Judge=Judging, Perceive=Perceiving

Table 5

Percentages of Dominant Type for Elementary Education Majors, Math Students, and Math Faculty

	Sens	Intu	Think	Feel
Elem	15	25	20	40
	n=3	n=5	n=4	n=8
M. Maj.	29	43	19	10
	n=6	n=9	n=4	n=2
M. Fac	0	25	50	25
	n=0	n=1	n=2	n=1

Elem=Elementary Education Majors, M. Maj=Math Majors, M. Fac=Math Faculty, Sens=Sensing, Intu=Intuitive, Think=Thinking, Feel=Feeling

Table 6
Percentages of Third Auxiliary for Elementary Education Majors, Math Students, and Math Faculty

	Sens	Intu	Think	Feel
Elem	25	15	40	20
	n=5	n=3	n=8	n=4
M. Maj	43	29	10	19
	n=9	n=6	n=2	n=4
M. Fac	25	0	25	50
	n=1	n=0	n=1	n=2

Elem=Elementary Education Majors, M. Maj=Math Majors, M. Fac=Math Faculty, Sens=Sensing, Intu=Intuitive, Think=Thinking, Feel=Feeling

Statistically Significant Differences Between Subscale Preferences, Dominant Type, and Third Auxiliary of Elementary Education Students and Math Majors

1. The proportion of Elementary Education Students (20%, n=4) who preferred Thinking on the Thinking-Feeling subscale of the MBTI differed significantly from the proportion of Math Majors (67%, n=14) who preferred Thinking.

$$z = -2.94 \quad p < .01$$

2. The proportion of Elementary Education Majors (40%, n=8) whose dominant type on the MBTI is Feeling differed significantly from the proportion of Math Majors (9.5%, n=2) whose dominant type is Feeling.

$$z = -5.5 \quad p < .01$$

3. The proportion of Elementary Education Students (40%, n=8) whose third auxiliary on the MBTI is Thinking differed significantly from the proportion of Math Majors (9.5, n=2) whose third auxiliary is Thinking.

$$z = 2.38 \quad p < .05$$

Statistically Significant Differences Between
Subscale Preferences of Elementary Education
Students and Math Faculty

1. The proportion of Elementary Education Students (45%, n=9) who preferred Sensing on the Sensing-Intuitive subscale of the MBTI differed significantly from the proportion of Math Faculty (0%) who preferred Sensing.

$$z = 1.67 \quad p < 0.1$$

2 The proportion of Elementary Education Students (20%, n=4) who preferred Thinking on the Thinking-Feeling subscale of the MBTI differed significantly from the proportion of Math Faculty (75%, n=3) who preferred Thinking.

$$z = -2.4 \quad p < .05$$

Conclusions and Discussion

Hypothesized differences (1, and 3, and 5) between elementary education students, math professors, and math students were not supported. The Productivity Environmental Preference Survey (PEPS) revealed no distinct profiles for any of the three groups that were tested. Of interest was the finding that the three groups were very similar in areas such as persistence, motivation and desired structure. It was concluded that differences among the groups in learning style as measured by the PEPS could not itself explain the conflict experienced between math faculty and elementary education students in the Math 105 course.

The Myers-Briggs Type Indicator revealed no significant differences between math students and faculty on MBTI subscales as well as in dominant

type or third auxiliary function. This confirms the hypothesis (4) of the study, which stated that math majors would not differ significantly in the personality type from math professors.

Results of the Myers-Briggs Type Indicator revealed that there were many significant differences between elementary education majors and the math majors and faculty, confirming hypotheses (2) and (6) which state that elementary education students would show significant differences in personality type from math professors and math majors. Significant differences between elementary education majors and math majors were found on the Thinking-Feeling subscale and in dominant type and third auxiliary. Significant differences between elementary education majors and math faculty were found on the Sensing-Intuitive subscale as well as the Thinking-Feeling subscale.

In addition, an important difference was also seen when the dominant type and third auxiliary of the elementary education majors and the math faculty were compared (See Tables 5 and 6). According to MBTI research, especially the work of Barger & Hoover (1984), when a teacher's dominant type (in this case, Thinking) challenges a student's third auxiliary (Feeling), the student may react in a number of ways. The reaction can range from inattentiveness to open resistance. According to the same study, it is entirely possible for a student to take on an emotionally defensive posture. It is concluded that differences in personality type and dominant type-third auxiliary of elementary education students and math faculty explain the reports of miscommunication, resistance and tension in the Math 105 course.

Recommendations

(1) Faculty and students, in general, could benefit from a better understanding of individual personality types and how these influence their approach to learning, to teaching, and to interpersonal relationships.

(2) This study should be replicated with a larger number of subjects for the purpose of generalizability. Of special importance is increasing the number of math faculty participants.

(3) Focused observations in mathematics classrooms could be of value in determining the effects of personality type on classroom interaction. Observations noting instructional style and classroom interaction of mathematics faculty who have "Feeling" as a dominant type could be compared to that of faculty with "Thinking" as a dominant type in order to identify specific differences in

   (a) approach,

   (b) student comfort level,

   (c) and the achievement of selected groups, such as females and minorities.

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Appendix
Strengths and Weaknesses of Each Type

Introvert	
independent	misunderstands the external
works alone	avoids others
diligent	secretive
reflects	loses opportunities to act
works with ideas	misunderstood by others
careful of generalization	needs quiet to work
careful before acting	dislikes being interrupted

Extravert	
understands the external	less independent
interacts with others	does not work without people
open	needs change, variety
acts, does	impulsive
well understood	impatient with routine

Sensor	
attends to detail	does not see possibilities
practical	loses the overall in detail
memory for detail, fact	mistrusts intuition
works with tedious detail	does not work out the new
patient	frustrated with the complicated
careful, systematic	prefers not to imagine the future

Intuitor	
sees possibilities	inattentive to detail, precision
sees gestalts	inattentive to the actual and practical
imagines, intuits	impatient with the tedious
works out new ideas	leaves things out in leaps of logic
works with the complicated	loses sight of the here-and-now
solves novel problems	jumps to conclusions

Thinker

logical, analytical	does not notice other's feelings
objective	misunderstands other's values
organized	uninterested in conciliation
critical ability	does not show feelings
just	shows less mercy
stands firm	uninterested in persuading

Feeler

considers other's feelings	not guided by logic
understands needs, values	not objective
interested in conciliation	less organized
demonstrated feeling	uncritical, overly accepting
persuades, arouses	bases justice on feelings

Judger

decides	unyielding, stubborn
plans	inflexible, unadaptable
orders	decides with insufficient data
controls	judgmental
makes quick decisions	controlled by task or plans
remains with a task	wishes to not interrupt work

Perceiver

compromises	indecisive
sees all sides of an issue	does not plan
flexible, adaptable	has no order
remains open to change	does not control circumstances
decides based on all data	easily distracted from tasks
not judgmental	does not finish projects

compiled by R. Craig Hogan and David W. Champagne from *Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator* by Myers & McCauley