Running Head: Teaching Styles of Science Teachers in Florida

# Patterns in Teaching Styles of Science Teachers in Florida and Factors Influencing Their Preferences

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*Abstract*

This study was an attempt to determine science teachers' teaching styles and to examine the relationships between these styles and teachers' demographic characteristics. To achieve these purposes, Teaching Style Inventory and Background Questionnaire were administered to science teachers in Tallahassee, Florida. Data analysis indicates that teaching styles are placed between teacher-student cooperation style and student-centered style. The results show some patterns between teachers' teaching styles and their educational majors, professional development, and years of experience.

## Introduction

Every teacher develops a particular way of going about the complex task of teaching. The way one introduces a topic, raises question, makes assignments- all these and hundreds of other behaviors together make up a teacher's classification by researchers, colleagues, and students. According to Trowbridge and Bybee (1996), the assumption underlying teaching style is that it is the most effective and efficient means of presenting the material as long as the style is appropriate for the subject and the students. Teaching styles develop understanding, skills, and values relative to the subject. In other words, teaching style describes the manner in which a teacher manages instruction and the classroom environment. This study was an attempt to determine science teachers' teaching styles and to examine the relationships between these styles and teachers' demographic characteristics.

## Literature Review

Various researchers have sought to examine teachers' teaching styles and classify them in many ways. Previous research studies illustrated a number of models that

characterizes different teaching styles. Dressel and Marcus (1982) and Woods (1995), for example, categorized teaching styles as discipline-centered, teacher-centered, and student-centered. In discipline-centered model, the course has a fixed structure. In teacher-centered model, the teacher is considered as an authoritative expert, the main source of knowledge, and the focal point of all activity. In this teaching model, students are passive recipients of the information. According to Lackey (1997), lecture obviously reflects teacher-centered style and requires a passive role for students. In student-centered model, on the other hand, instruction focuses on the student and his/her cognitive development. The teacher's goal is to help students grasp the development of knowledge as a process rather than a product.

Flanders (1970) used different terminology and named teacher-centered teaching as direct style, student-centered teaching as indirect style and discipline-centered teaching as eclectic style. Weinberg (1983) also did some work on teaching styles and identified the following four teaching styles: direct teaching, peer teaching, problem solving, and group approach. First, in direct teaching style, the teacher makes all of the decisions. S/he describes and demonstrates what is to be learned, evaluates it and gives feedback. This style needs very little cognitive or affective involvement on the student's part. Second, peer teaching style pairs two students of differing ability levels with one another. The teacher describes and demonstrates the desired response. The students evaluate each other using criteria presented by the teacher. Third, in problem solving style, the teacher sets a problem and the students respond it in most appropriate ways for them. Models come from student creativity and other students' responses. And last, group approach style is used to foster social skills as well as promote acceptance among different ability levels.

Briefly, it looks meaningful to summarize that teacher-centered style is traditional and requires lecture. In discipline-centered style, however, teachers appear to place subject matter knowledge as the central focus of their beliefs and actions instead of placing teaching or students at the center. Programmed learning materials, printed study guides, prepared curricular materials, and research papers can be used (Lackey, 1997). Discipline-centered teaching strategies tend to be teacher-centered, but also include hands on activities, laboratories, demonstrations, group work and discussion. Therefore, this technique creates students with positive learning environment to clarify their understanding and present their ideas (Patricia, et.al., 1999). In short, discipline-centered teaching style has characteristics of both teacher-centered style and student-centered style. Hence, using discipline-centered style as transitional style may be acceptable. In student-centered style, activities such as group discussions and group or individual reports are used (Lackey, 1997). This style is individualized to provide accommodation to students' cognitive, affective, behavioral and physical needs during the teaching and learning process (Shreves, 1998). It seems from these two statements that student-centered style refers to individualized teaching approach.

Dunn and Dunn (1977) developed an instrument called Teaching Style Inventory to classify the teaching styles from individualized to transitional through traditional. They indicate that teachers with individualized teaching style are responsible for diagnosing, prescribing for, and guiding each student in the class through the learning process. According to their idea, students and teachers should be paired so that they encourage one another. Consequently, in the individualized classrooms, teachers may find more opportunities to reach this view or style. Traditional teaching style is described as a teacher-directed approach

while in transitional style, both teacher and students are expected to assist each other during the teaching and learning process (Dunn & Dunn, 1977).

Another approach to teaching styles was stated by Grasha in 1994. He developed the Teaching Style Inventory and administered it to 381 faculty members to gauge the distribution of teaching styles across gender, academic rank, course level, and academic disciplines based on these styles. Grasha (1996) identified five teaching styles named as expert, formal authority, facilitator, delegator, and personal that represented typical orientations and strategies college faculty use. Berger (1974), in addition, determined three kind of teaching behaviors as teacher oriented, student oriented, and student-teacher cooperation oriented.

The effect of teaching style on student achievement determined by a number of researchers (e.g., Lawrenz and Lawson, 1986; Lawrenz, 1988; McKenna, 1983; Wolfson, 1973; Yeany, 1975). For instance, Wolfson (1973) used Flander's (1970) classification as direct (D) and indirect teaching (I) and studied the relationship of teachers' I/D ratio with their students' achievement and retention of learning in senior high chemistry and junior high general science classes. He indicated that the student's score on a standardized achievement test was dependent upon the teacher I/D ratio as measured on Flander's scale.

Studies show that matching teaching styles to learning styles can significantly enhance academic achievement, student attitudes, and student behavior at the primary and secondary school level (Griggs and Dunn; Smith and Renzulli, as cited in Felder, 1995) and at the college level (Brown; Charkins et al. as cited in Felder & Henriques, 1995). Stress, frustration, and burnout may occur when students are subjected over extended periods of time to teaching styles inconsistent with their learning style preferences (Smith and Renzulli

as cited in Felder and Henriques, 1995). Moreover, Charkins and his colleagues (1985) suggested that student achievement might be improved by a better match between the teaching style of instructors and the learning style of students. Wahl (as cited in Keri, 2002) discovered that specific learning styles were complemented by certain teaching styles, and recommended that faculty members assessed their own teaching styles in order to both satisfy and advance the learning needs of students. In addition, Dunn and Dunn (1991) and Kolb (1981 and 1985) evidenced that students whose learning styles matched their instructors' teaching styles achieved higher grades than those who did not (as cited in Keri, 2002). Dunn (1993) reviewed several research findings on students' learning styles and their achievement at college, secondary and elementary school levels. Her findings indicate that matching student learning styles with teaching styles had a positive effect on achievement scores, attendance, attitude towards school, and motivation for additional education. Bigge and Shermis (1999) and Schunk (1996) also concluded that teaching styles should match with students' learning styles.

Another factor, which may influence the type of teaching style, is teachers' attendance at professional activities related to teaching and learning such as conferences and workshops. The interest on professional activities has been growing due to the fact that the National Science Education Standards advise prospective and practicing teachers to attend professional activities to develop theoretical and practical understanding and ability in science for their continuous professional growth and development ( National Research Council, 1996). Ojure and Sherman (2001) revealed that a multiple set of embedded factors played a vital role in defining the teacher's interest and the most important factor was concerned with professional growth and preparation in the field. Based on teachers' own

responses, researchers reported that a professional experience provide teachers with an opportunity to really think through what they do, and why they do it, and for whom they do it (Ojure & Sherman, 2001). Research also suggests that "the more extended or ongoing and continuous the professional development", the more it encourages effective classroom practices" (Wenglinsky 2000, p. 30). Therefore, it is expected that teachers' teaching style would tend to run student-centered classes with an emphasis on encouraging student participation if teachers regularly participate in professional activities in the field.

Eventually, each teacher will find certain forms of teaching that fit his or her own teaching and learning goals, interactions with students, and professional or personal characters. Since personal teaching style is the main influence on a classroom-learning environment, we as educators, researchers or curriculum developers should be aware of what it is and how it is related to the factors (e.g., background) to build an effective science-learning environment.

## Purposes of the Study

This study examined the teaching styles of science teachers in Tallahassee, Florida. The main purpose was to portray science teachers' teaching styles on the continuum described as individualized, transitional or traditional using the Teaching Style Inventory. Secondarily, it was aimed to determine factors that had influence on teachers' teaching styles.

Research indicates that demographics of a teacher may influence his/her choice of teaching style. For instance, Shulman (1990) highlighted that new teachers prefered to use teaching styles similar to those used by their own teachers. The author also stressed that as the teacher gained experience, his or her teaching style was likely to change. Therefore, the

study also attempted to examine the relationships between these teachers' teaching styles and their demographic variables such as gender and teaching experience, in order to reach more valuable information. The study addressed the following research questions:

- What is the pattern in teaching styles of science teachers in Florida?
- Do teachers' demographics have any influence on science teachers' teaching style? If any, what are the relationships between teachers' teaching styles and their demographics?

## Methodology

The questions posed in this study were examined using quantitative methods. Outlined below is a discussion of the methods used for sampling, description of the study variables, data collection and analysis.

### *Subjects*

The population for the study was the science teachers in Tallahassee, Florida. The Teaching Style Inventory was mailed to 100 randomly selected science teachers in Tallahassee. The science teachers from middle school to high school levels were teaching in various counties in Tallahassee.

### *Instruments and Data Analysis*

The science teachers' teaching styles were measured by using "Teaching Style Inventory" (TSI) created by Dunn and Dunn in 1977 and revised in 1993, and the teachers' demographics were determined by using "Background Questionnaire". TSI was used to produce a profile of teachers' instructional characteristics that included "Traditional" (recitation and drill), "Transitional" (whole-class approach), and "Individualized" instruction. The instrument consisted of 35 items assessed on 5-point Likert scale designed to measure

teachers' teaching styles. Four factors described as instructional planning, teaching methods, teaching characteristics, and teaching environments were used to define teaching style. Statements on the inventory are based directly on the objectives assigned to or selected by the students (Dunn and Dunn, 1993). Background Questionnaire was designed by the researchers to collect demographic information about teachers like their age, gender, earned highest degree, and teaching experience and searched for whether they match teaching and learning styles and the participation of professional development activities.

The teachers' teaching styles from individualized to transitional to traditional were calculated by summing responses across items and then averaging. The reliability estimate for the teaching style scale was calculated using the Cronbach Alpha formula. This approach was used to test for internal consistency because the questionnaire contained many Likert-type items (Cronbach, 1951).

In order to explain the effects of teachers' demographics on their styles, a multiple regression analysis was performed in SPSS. Before assessing overall relationship, preliminary analyses were conducted in several steps including missing subjects and data analysis, case analysis to identify outliers, and assessment of violations of assumptions.

*Description of the Variables*

This study have one outcome measure relevant to teachers' teaching styles and five sets of predictor measures describing characteristics of teachers. The specifics of how these measures were constructed are described below. Table 1 also provides a complete summary for description of the study variables that were utilized during the analysis of the data.

Outcome Measures

Teaching Style: This is a composite measure of teachers' teaching style provided by a teaching style inventory including four subscales: (1) Instructional planning, (2) Teaching methods, (3) Teaching characteristics, and (4) Teaching environments.

Predictor (Independent) Measures

Highest degree earned**:** This measure was drawn from teachers' responses to the item asking the type of education degree they had earned. The measure was further classified into two categories as bachelor's degree or less, and others including master's degree, educational specialist, and doctorate degree.

Participation in professional development activities: This measure refers to teachers' responses to the item asking how frequently they participate in professional development activities related to teaching and learning in the field of science education. Their responses were further classified into two categories: frequent (10 or more than 10 hours) and non-frequent participants (less than 10 hours within a year).

Matched learning and teaching styles: This measure was drawn from teachers' responses on the item asking whether teachers taught any concepts in science considering students' learning differences. Based on teachers' responses, this measure was further classified into two categories: "Yes" referring to teachers who matched their teaching styles with students' learning styles and "No" indicating that teachers did not link teaching technique with their students' learning styles.

Gender: This measure refers to teachers' gender coded as female and male.

Teaching experience: This measure is a sum of total number of years that teachers taught full time and part time in public and private schools. The sum is classified into three categories: 4 and less than 4 years, 5 to 9 years, 10 and more than 10 years.

Table1. Description of the variables in the study

| | |
|---|---|
| | Outcome Variable |
| Teaching Style | This is a composite measure of teachers' teaching style provided by a style inventory including four subscales as instructional planning, teaching methods, teaching characteristics, and teaching environments. |
| | Dichotomous Variables |
| Highest Degree Earned | A dummy variable. It shows a teacher's degree in education. Teacher with a bachelor degree is coded as "0", while others (masters and doctorate levels) are coded as "1". |
| Professional Development Activities | A dummy coded variable. It refers to whether a teacher regularly participates in any professional activities related to teaching and learning. Teachers who frequently participate in training activities are coded as "1", while others (non-frequent participants) are coded as "0". |
| Matched Learning and Teaching Styles | Dummy coded variable indicates whether a teacher considers students' learning styles or matches learning and teaching styles in the process of teaching. Teachers' responses were coded as "1" if they said yes, and "0" if they said no. |
| Gender | Female teachers were coded as "1" while male teachers were coded as "0". |
| | Categorical Variables |
| Teaching Experience | This shows teachers' teaching experiences presented in years. It consists of three categories as;<br>• 4 and Less than 4 years<br>• Between 5 and 9 years<br>• 10 and More than 10 years |

## Results

For this study, 100 surveys were sent to science teachers, 92 surveys were returned (N=92) and 92 percent response rate was obtained. 30 percent of the respondents were male and 70 percent were female. The results of this investigation indicate that the styles of teachers are placed between transitional and somewhat individualized (M= 3.43 on a 5-point scale) (See Figure 1). With respect to their teaching characteristics, they are close to

individualized style (M= 4.2). Considering subscales as instructional techniques, teaching methods and teaching environment, the teachers are approaching to individualized teaching style. It reflects that almost no teacher in this study tends to use a traditional teaching style.

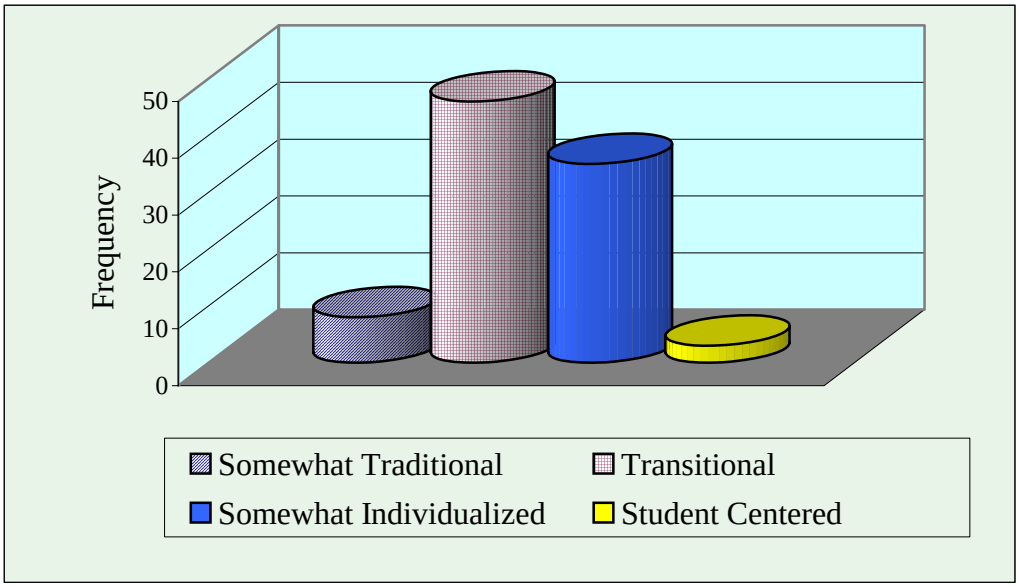


Figure 1. Distribution of the teachers' responses on the Teaching Style Inventory.

Internal reliability was measured by using coefficient alpha developed by Cronbach (1951). The reliability results were high for the instrument (overall- alpha= .83). Cronbach Alpha values were 0.75, 0.61, 0.58, and 0.74 for each factor of instructional planning, teaching methods, teaching characteristics, and teaching environments, respectively. The discriminant validity of the scale was examined by comparing total teaching style scores across the two groups of teachers. One group refers to participants who participated in professional development activities 10 or more than 10 hours within a year whereas another group of teachers did not frequently attend in those activities (less than 10 hours in a year).

The independent *t*- test result indicated that the group which frequently participated in professional activities (M = 3.51, SD=.31) reported utilizing significantly more student-centered teaching practices than did the other group, not frequently participated in professional activities (M = 2.97, SD=.19), $t$ (96)=1.98, $p<.05$. This means that science teachers who participated in any of the professional development activities for 10 or more than 10 hours within a year seem to use more student-centered approach in classrooms than those who participated approximately for less than 10 hours in a year. As it was predicted, greater frequency among teachers who engaged in professional activities was positively related to teachers' teaching styles.

Table 2. Group Statistics

| Group | n | Mean | SD |
|---|---|---|---|
| Less than 10 hours | 21 | 2.97 | .19 |
| 10 or more than 10 hours | 77 | 3.51 | .31 |

The 32-items were subjected to principal component analysis by using varimax rotation. The explanatory factor analysis generated nine factors with an eigenvalue of one or greater than one, which explained the 64.35 percent of the total variance in the data. An additional test, called scree plot analysis or scree test, was used to examine number of factors and to verify number of significant factors. The scree plot is presented in Figure 2 below.

Dillon and Goldstein (1984) suggested that the number of components (factors) can be retained which is given by the point at which the components curve above the straight line formed by the smaller eigenvalues (p.49). In other words, the number of factors can be taken into consideration before the scree plot curve breaks and the pattern of remaining factors is a

relatively straight line on the curve. Based on our analysis, Figure 2 illustrates the generated factors on the scree plot. The arrow on the Figure 2 shows the point at which the contour of the curve changes significantly. Before this break point, four factors were retained with an eigenvalue of 1.8 and greater.

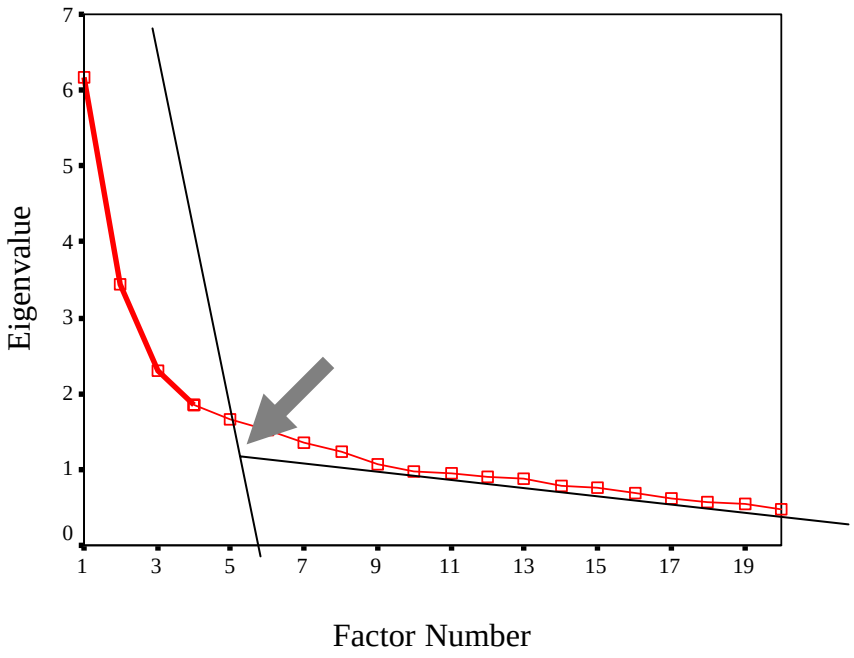


Figure 2. Illustration of the scree test

Furthermore, we conducted a confirmatory factor analysis using 32 items to determine the construct validity of each factor retained. These items loaded across four factors, which accounted for 43.10% of the total variance on the scores of science teachers' teaching styles. The item loadings across the four factors, the variance accounted by each factor, and cumulative across them are reported in Table 3. Factor 1, referring to the subscale of instructional planning, accounted for the 13.12 % of the total variance in the data. Moreover, Factor 2 (student grouping), Factor 3 (teaching characteristics), and Factor 4

(teaching method) explained 12.68 %, 11.20 %, and 6.00 % of the variances, respectively, in the data.

Table 3. Factor loadings for Teaching style Inventory of Science Teachers

| | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---|---|---|---|---|
| IP1 | .740 | | | |
| IP2 | .600 | | | |
| IP3 | .375 | | | |
| IP4 | .510 | | | |
| IP5 | .492 | | | |
| IP6 | .637 | | | |
| IP7 | .327 | | | |
| IP8 | .725 | | | |
| IP9 | .662 | | | |
| IP10 | .401 | | | |
| IP11 | .616 | | | |
| IP12 | .379 | | | |
| TM1 | | | | .467 |
| TM2 | | | | .337 |
| TM3 | | | | .572 |
| TM4 | | | | .553 |
| TM5 | | | | .478 |
| TM6 | | | | .795 |
| SG1 | | .741 | | |
| SG2 | | .651 | | |
| SG3 | | .489 | | |
| SG4 | | .550 | | |
| SG5 | | .523 | | |
| SG6 | | .475 | | |
| TC1 | | | .554 | |
| TC2 | | | .582 | |
| TC3 | | | .596 | |
| TC4 | | | .536 | |
| TC5 | | | .561 | |
| TC6 | | | .618 | |
| TC7 | | | .622 | |
| TC8 | | | .688 | |
| % Variance | 13.12 | 12.68 | 11.20 | 6.00 |
| % Cumulative Variance | 13.12 | 25.80 | 37.00 | 43.10 |

IP= Instructional Plan, TM= Teaching Method, SG= Student Groupings, TC= Teaching Characteristics

Science teachers' teaching styles were modeled with five independent variables: teaching experience, gender, highest degree earned, participating frequency of professional development activities and existence of matched learning and teaching styles. There were no missing data for the variables of interest for those responding to the survey.

No outliers were identified after investigation of all scatter plots and studentized residuals values (-2.157, 2.339). In order to detect whether there was any violation of the regression assumptions in terms of correct fit, constant variance, or normality, a visual inspection was conducted. It showed that there was no violation regarding a plot of the model residuals versus the expected outcomes. Additionally, no conditions indicated the possibility of a violation associated with the independence assumption.

Considering the results from a multiple regression analysis, the model $R^2$ of 0.73, reflecting the overall strength of relationship between types of teaching styles and independent variables, which were used in the model, was statistically significant at the 0.05 level (F=37.91, $F$ [.05; 6, 85]= 2.77, $p< 0.05$). It is concluded that the selected study variables were explained the 73% of the accounted variance on level of teachers' teaching styles. The standard error of estimate was 0.38. The effects of the individual independent variables on teaching styles are summarized in the Table 4.

Table 4. Science Teachers' Teaching Styles Results Summary

| Variable | Effect Estimate | 95% Confidence Interval | $\Delta R^2$ |
|---|---|---|---|
| Highest Degree Earned | .155** | .048, .388 | .145[a] |
| Professional Development Activities | .531** | .525, .978 | .373 [a] |
| Matched Learning and Teaching Styles | .316** | .235, .675 | .232 [a] |
| Gender | .009 | -.150, .177 | .018 |
| Teaching Experience | | | .007 |
| 4 and 4< years | .032 | -.169, 297 | |
| 5-9 years | .092 | -.051, .373 | |
| 10 and 10> years | -.088 | | |

[a] $\Delta R^2$ is the increase in $R^2$ due to adding each independent variable last, given the other independent variables.
** Significant at the 0.01 level.

The regression analysis of the teaching styles data results in the following sample model;

$$\hat{Y} = 2.604 + 0.155\ X_1 + 0.531\ X_2 + 0.316\ X_3 + 0.009\ X_4 + 0.032\ X_5 + 0.092 X_6 - 0.088 X_7$$

The resulting interpretations of the estimated predictor variables' effects are:

*Highest Degree Earned:* The predicted teaching style for the group of teachers having a graduate degree is 0.155 units greater than that for other group with a bachelor degree in the field of education.

*Participation of Developmental Activities*: The estimated level of teaching style for the group that regularly participates or participated any professional activities related to teaching and learning is 0.531 units greater than that for others, who do or did not participate these kinds of activities.

*Existence of matched learning and teaching styles:* The expected level of teaching style for the group considering students' learning styles or matching learning and teaching styles is 0.316 units higher than that for the teachers, who do not consider learning preferences.

*Gender:* The predicted rank of teaching style for female teachers is 0.009 units greater than that for male teachers.

*Teaching Experience:* The ranking of the highest degree earned groups with respect to the predicted level of teaching styles from highest to lowest is 5 to 9 year-experienced teachers, 4 or less than 4 year-experienced teachers, and 10 or more than 10 year-experienced teachers. Considering three associated pair wise comparisons, the group that has 4 or less than 4 years teaching experience has a predicted outcome 0.032 greater than the group that has 10 years experience. The group having 5 to 9 years experience has an expected outcome 0.092 higher than the group that has 10 or more than 10 years experience. The group that has 4 or less than 4 years teaching practice has a predicted outcome .0088 less than the group having experience between 5 to 9 years.

## Conclusion and Directions for Future Research

The main result of the study reveals that a large number of science teachers tends to use individualized-teaching style in their teaching and learning environments. This is evidence that those teachers carry these crucial responsibilities of diagnosing, prescribing for, and guiding each student all the way through the learning process. Additionally, they believe the idea that students and teachers need and encourage each other so that they stimulate one another. In other words, teachers leaning toward more student-centered teaching approach match their teaching styles with students learning styles at any level of teaching process.

The evidence from the data shows that teachers with higher degree in the field of education hold more student-centered teaching styles. It is clear that additional pedagogical and content specific designed courses in higher levels promote confidence for teachers to evaluate teaching and learning process. It also provides them with recent theories to update their knowledge in the field.

Moreover, the data from this study suggest that participation of professional activities (e.g., workshops, training) favors more student-centered approach. We believe that various kinds of professional activities related to teaching and learning would shape teachers' teaching preferences and styles and these activities also provide teachers with specific, practical materials and strategies for giving students systematically more instructional choices in the classroom.

It would be appropriate to conclude from the data that a teacher considering matching his/her teaching style with students' learning styles tend to construct his/her instructional theory in more individualized-teaching environment. This conclusion can be predicted due to the fact that individualized-teaching style gives enormous importance to student learning.

Results related to teachers' experiences in education reveal a different pattern comparing to other effects in the model. Teachers with experience from 1 through 9 years are more likely to utilize a student-directed approach comparing to more experienced teachers. Teachers who recently graduated from college could be more aware of new innovative teaching and learning techniques than teachers who have more than 9 years of experience.

This study provides some information about science teachers' teaching styles living in Tallahassee, Florida. The study also determines some patterns between teachers' demographics and their teaching styles. Further research is suggested using larger sample

sizes even though the results support the reliability of the instrument. A larger sample size would also allow researchers to run a stepwise regression analysis to demonstrate the most important predictors of teachers' teaching techniques.

Future research would concentrate on other possible teachers' demographics to detect contributors influencing teachers' teaching styles and instructional techniques. It could also be a potential research on comparisons of regional differences of teachers' styles and the variability of factors affecting their decisions and styles.

Some qualitative research methods would be used to validate these quantitative research findings. In order to do that, a certain amount of teachers could be randomly selected from the teachers, who had the lowest and highest scores on the teaching style instrument. Then, they could be interviewed and observed in real school settings. We believe that both research traditions would be contributing the research findings in terms of understanding aspects affecting science teachers' teaching styles.

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