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Learning Style and Laboratory Preference: A Study of Middle School Technology Education Teachers in Virginia

Philip A. Reed

Laboratory instruction has long been a cornerstone of technology education pedagogy. The French realized the potential for technical laboratory instruction within general education in 1865 (Bennett, 1926). By the 1880s, the United States also realized the benefits of the technical laboratory for general education (Anderson, 1926). Despite these early roots and the continued practice of utilizing laboratory instruction within technology education, there is little research to support this teaching method. McCrory (1987) noted that there were no studies on laboratories (excluding machine safety) or new technology education equipment during the period 1980-1986. Laboratory studies during the period 1987-1993 concentrated on curriculum and did not focus on new instructional methods and strategies (Zuga, 1994).

The adoption of modular technology education has only heightened the need for research on laboratory instructional methods. Since the middle of the 1980s, modular technology education has grown considerably. Brusic and LaPorte (2000) found that almost half of the technology education teachers they surveyed in Virginia taught in some type of modular lab. Despite such emerging research, opinions concerning the merit of modular technology education, especially commercially created packages, dominate the field of technology education. To address these opinions, this study investigated whether the preference for a conventional or modular laboratory is influenced by the learning style of the teacher.

Related Literature

Modular Laboratories

Modular technology education (MTE) labs have been widely implemented in secondary technology education programs during the last two decades. The Gestalt principle of summation, which states that the whole is more than the sum of its parts (Rothstein, 1990), along with the teaching machines of B. F. Skinner, appear to have influenced the creation of MTE. Other aspects of the "behavioral systems family" (Joyce, Weil, & Calhoun, 2000) appear to have influenced the development of MTE through such methods as programmed instruction, self-training, and learning from simulations.

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The "teaching machine" research of B. F. Skinner (1968) created a wealth of classroom investigation and curriculum development. This line of research soon became known as programmed instruction. Programmed instruction was characterized by small instructional steps, active student involvement, immediate confirmation or reinforcement, and self-pacing. T. Neville Postlethwait is credited for using programmed instruction to create "a small unit of subject matter which could be treated coherently as an individual topic and could be conveniently integrated into a study program" (Russell, 1974, p. 3). Postlethwait used audio and self-instructional carrels to create "micro-courses" that were centered on content objectives. Similar instructional methods were soon developed under titles such as "concept-o-pac," "instruc-o-pac," "unipak," "learning activity package" (LAP) and "individualized learning package" (ILP) (Russell, 1974, p. 3).

In the early 1970's the term "module" emerged as a generic description for individualized learning packages (Bolvin, 1972). Russell's definition of a module could easily describe the packages currently being used by technology education:

> A module is an instructional package dealing with a single conceptual unit of subject matter. It is an attempt to individualize learning by enabling the student to master one unit of content before moving to another. The multi-media learning experiences are often presented in a self-instructional format (Russell, 1974, p. 3).

In technology education, Johnston (1986) used the work of Russell (1974) to compare the effectiveness of conventional and modular instruction in a high school manufacturing class. Four written modules were created and presented to one class while a second class was taught with conventional instruction. Johnston found that students who received conventional instruction achieved higher scores on a post-test than students who received modular instruction. Although Johnston's research appears to be the earliest work dealing with modular instruction in technology education, his findings are limited since the research only involved two classes at one high school.

When the American Industrial Arts Association (AIAA) changed its name to the International Technology Education Association (ITEA) at the 1985 San Diego conference, concerns over content and facilities resulted (Dean, 1997). After the conference, Max Lundquest and Mike Neden returned to Pittsburg, Kansas to create a middle school laboratory that would reflect their vision of the new technology education paradigm. According to Dean (1997), the current form of MTE was created at Pittsburg Middle School.

Many polemic papers have been written which discuss the advantages and disadvantages of MTE (e.g., Petrina, 1993; Gloeckner and Adamson, 1996; Pullias, 1997; Starkweather, 1997; Rogers, 1998a). Several studies support concerns involving student achievement in MTE. Rogers (1998b) studied seventh grade technology students in three Nebraska technology programs. The findings suggested that the achievement gain of students in a contemporary lab (up-to-date technology education lab with modern equipment) were significantly greater than students in a traditional lab (industrial arts shop) and those in a modular lab.

In another experimental study, Weymer (1999) used demographic variables, the Group Embedded Figures Test, and several other test scores to determine how 142 sixth-grade technology students performed in an engineering structures module. He determined that many of the field dependent students (scores $\leq$ 0.5 *SD* below the sample mean) and field intermediate students (scores between -0.5 *SD* and +0.5 *SD* of the sample mean) were lost in a modular lab. He felt that many of the students did not have the verbal skills necessary to follow the self-paced format of modular instruction. Weymer also concluded that a modular laboratory might not be appropriate for all types of learners.

Conventional Laboratories

William E. Warner wrote that society had changed after World War II from an industrial complex to an elaborate social environment that consisted of producers, consumers and managers of technology. This view is expressed in Warner's *A Curriculum to Reflect Technology* (1947). One of the notable suggestions by Warner was the use of a general area shop as opposed to the traditional unit shop. Warner's vision of the general area shop included tools and machines that could be used for a variety of materials and processes as opposed to the unit shops' focus on one material or process.

Delmar W. Olson's dissertation and subsequent publication, *Industrial Arts and Technology* (1963), expanded Warner's notion of using technology as the content base of industrial arts. *Industrial Arts and Technology* also contained many sample laboratory designs. When reviewing these designs, one can clearly see how Olson took the general area shop to a new level. Many of the designs are arranged in a modular format. It is important to note, however, that Olson did not intend these lab areas to be autonomous curriculum units. On the contrary, Olson envisioned flexibility in his labs with student's moving between stations and utilizing the tools and materials in an integrated manner. The influence of Olson's work upon industrial arts philosophy, curriculum, and laboratory development in the 1960's is apparent in such projects as The Maine Plan (Maine State Department of Education, 1965).

The American Council on Industrial Arts Teacher Education (ACIATE) has published several yearbooks that focus on technology education facilities. The eighth ACIATE yearbook published in 1959 detailed existing laboratories, equipment selection, architecture, and planning and evaluation procedures. This yearbook contained numerous photographs, reference lists and sample laboratory layouts (Nair, 1959). To reflect the unparalleled period of curriculum changes during the 1960's and as a reaction to the popularity of the eighth Yearbook, the ACIATE published a second yearbook on facilities in 1975.

The twenty-fourth ACIATE yearbook included many of the features of the eighth yearbook but also contained facility information for many of the curriculum projects created in the 1960's. Specifically, the 1975 yearbook presented facility information for the following curriculum projects: American Industry Project, Georgia Plan, Industrial Arts Curriculum Project, Maryland

Plan, Occupational Versatility, and the Orchestrated Systems Approach. In addition, information was provided on transportable industrial arts laboratories and the emerging field of visual communications (Moon, 1975).

To reflect the name change from Industrial Arts to Technology Education and the paradigm shift of curriculum based on industry to curriculum based on technology, the ACIATE (renamed the Council on Technology Teacher Education [CTTE] in 1986) created a series of six yearbooks related to content, facilities, and instruction. The first two yearbooks in the series, 1986 and 1988, established the conceptual foundations for technology education (Israel, 1994).

The 1990-1994 CTTE Yearbooks were each based on one of the content organizers outlined in the *Jackson's Mill Industrial Arts Curriculum Theory* (Snyder and Hales, 1981). The four CTTE yearbooks dealing with communication, transportation, manufacturing, and construction each contain a chapter on facilities. Although these chapters focus more on content than on physical characteristics, their differences from earlier facilities yearbooks can be seen in several ways. First, there was considerable emphasis on studying the impacts of technology. Second, laboratory areas for research and experimentation are suggested. Both of these concepts, however, are not new to technology education (see Olson, 1963; Maley, 1970; Earl, 1960).

In summary of this section, many of the conventional facility plans reviewed are strikingly similar, regardless of their age. Although the title *Industrial Arts* was changed to *Technology Education* in 1985 by the International Technology Education Association, industrial arts courses such as woodworking still dominated secondary instruction in 1991 (Dugger, French, Peckham, Starkweather, 1992). Even as late as 1995, secondary principals in North Carolina still believed woodworking and metalworking should be a part of technology education (Jewell, 1995). More recently, Sanders (2001) found that curriculum, philosophy, and course titles within secondary technology education in the United States are still in a state of flux.

Teaching Styles

Contemporary literature on teaching and learning styles supports the notion that teachers should understand their own teaching and learning styles in order to be more flexible (Claxton and Ralston, 1978; Dunn and Dunn, 1979; Cornett, 1983; Marshall, 1991). Historically there have been three dominant methods of analyzing teaching behavior. In the beginning of the nineteenth century, studies focused on student perceptions of their instructor. The second phase of teaching style research began in the 1930's and focused on observing teachers in an attempt to identify similar characteristics. The third method of analyzing teaching behavior began in the 1960's. These studies identified effective teaching behaviors and then created instruments to examine other teachers. The current research on teaching styles is heavily grounded in this third method (Silvernail, 1986).

Despite significant research by Bennett (1976), Flanders (1970), and others, teaching style research contains several inherent problems. First, the research is time-intensive. Second, validity and reliability are serious issues due to the qualitative methods used by many teaching style studies. Third, the theme that teachers should utilize a variety of teaching styles is echoed throughout the literature (Bennett, 1976; the National Association of Secondary School Principals, 1979; Guild and Garger, 1985; McCarthy, 1987; Mosston and Ashworth, 1990).

Learning Styles

Jung's (1923) *Psychological Types* is cited as the beginning of modern learning style theory (Lawrence, 1982; Guild and Garger, 1985). Jung established four learning styles that are defined by the way individuals perceive new information and how they judge new knowledge once in consciousness. Jung, however, never developed his theory of psychological type for practical use through instruments or models. The use of model formulation in learning style theory is attributed to organizational psychologist David A. Kolb (McCarthy, 1987).

McCarthy (1979, 1987) reviewed the work of twelve learning style researchers from various disciplines and found that almost all of the theories defined two ways of perceiving information and two ways of processing information. Next, McCarthy synthesized the strands from each theory and placed them into Kolb's (1984) model. McCarthy was thereby able to develop composites of four different types of learners to create the 4MAT System of learning and instruction. Finally, work from Carl Jung, David Kolb, Kurt Lewin, Isabel Myers, Joseph Bogen, and Bernice McCarthy were used to create the Learning Type Measure (LTM) instrument which could be used with the 4MAT System of learning and instruction. Part A of the LTM is used to assess the four learning styles identified by the 4MAT System: Analytic, Common Sense, Dynamic, and Imaginative. Part B of the LTM identifies how individuals process new learning. *Watchers* tend to engage in subjective introspection before acting on information or experience. People who prefer *Doing* act first and then reflect on their actions.

Many instruments designed to measure learning style have encountered criticism from the broader psychological community for their lack of validity and reliability (Sadler-Smith, 1997; Stahl, 1999). The 4MAT System model and LTM, however, were selected to describe the learning styles of technology education teachers in Virginia because of their established validity and reliability (McCarthy, 1987; Excel, 1998).

Purpose

This study was designed to describe the learning styles of modular and conventional laboratory teachers in the Commonwealth of Virginia. Based on support in the literature that suggests a relationship between teaching and learning styles, it was hypothesized that teacher preference for one type of laboratory over another (conventional or modular) may be an issue of learning style. This study was also designed to highlight the need for technology educators to understand their learning style and how it influences their teaching style. A third purpose was to determine whether technology teachers have different learning styles from secondary teachers in general.

Procedures

A random sample (n = 195) was drawn from the entire population (as identified by the Virginia Department of Education in 1998) of public middle school technology education teachers (N = 392). Randomly selected teachers were mailed a cover letter, demographic questionnaire, postage-paid return envelope, the Learning Type Measure (LTM) instrument (Excel, 1998), and one dollar for taking the time to complete and return the materials. The demographic questionnaire included questions on gender, the type of laboratory in which the majority of technology instruction took place (conventional or modular), the respondent's preferred laboratory (conventional or modular) for implementing Virginia's middle school curriculum, and the amount of respondent's teaching experience. The LTM is a paper and pencil instrument that is well grounded within learning style research. Based on the work of Carl Jung, David A. Kolb, Kurt Lewin, Isabel Myers, Joseph Bogen, and Bernice McCarthy, the LTM is a reflection of:

1. Situational adaptations of Jung's constructs of feeling, thinking, sensing, intuition, extroversion, and introversion,
2. Behaviors modeled after Kolb's constructs of concrete experiential, reflective, abstract, and active learners,
3. Representations of hemispherity drawn from Bogen, and
4. McCarthy's field work (Excel, 1998, p. 3).

Data collected were compared using contingency tables and Pearson's Chi-square analysis. The learning styles of modular laboratory teachers were compared to the learning styles of conventional laboratory teachers. The respondents' learning styles were also compared to the findings of 2,367 other secondary administrators and teachers who participated in 4MAT workshops between 1986-1987 (McCarthy, 1987).

Findings

Eighty-three (42.5%) of the teachers surveyed returned their instruments. Of these, sixty-five were usable for an overall response of 33.3%. Sixty-percent of respondents (n = 39) teach the majority of their classes in a modular lab while only forty-percent (n = 26) teach in a conventional laboratory. Conventional laboratory teachers had slightly more teaching experience (mean = 18.4) than modular laboratory teachers (mean = 16.7). Respondents were asked if the laboratory in which they currently taught technology education was their preferred laboratory for implementing Virginia's middle school curriculum. Table 1 illustrates the crosstabulation of laboratory environment and laboratory preference. Although this finding was not statistically significant, it does demonstrate that conventional laboratory teachers are not as satisfied with their current environment as modular laboratory teachers.

Eleven non-respondents (10%) were randomly drawn and contacted by telephone. The data were collected on gender, laboratory environment, laboratory preference, and teaching experience. Learning style could not be assessed over the telephone because of the length of the LTM. Analysis of variance found no significant difference between the selected non-respondents and respondents among the selected variables.

Table 1
Comparison of Respondents Preferred Laboratory to Current Laboratory

	Preferred Laboratory			
Current	Modular		Conventional	
Laboratory Environment	*n*	%	*n*	%
Modular	33	84.6	6	15.4
Conventional	8	30.8	18	69.2

Due to low frequency counts in some of the learning style cells, several learning style categories were combined to maintain the validity of the Chi-square and contingency table analysis. It was felt that the pooling of categories would not have an adverse effect since the data were collected for descriptive purposes only. Since a large number of respondents were Common Sense learners, this category did not need to be pooled. The three remaining learning styles, Imaginative, Analytic, and Dynamic, were all pooled due to cell size. Table 2 illustrates the inverse relationship between the respondents of this study and McCarthy's (1987) national study of secondary teachers and administrators ($n = 2{,}367$). This relationship must be viewed cautiously however, since the number of administrators in McCarthy's (1987) sample could not be determined.

With regard to the first hypothesis, the learning styles of conventional laboratory and modular laboratory respondents did not differ significantly from the learning style proportions of all respondents, χ^2 (3, $n = 65$) = .301, $p < 960$. Table 3 illustrates that the observed frequencies of the laboratory environments and learning styles did not differ from expected values more than would be predicted by chance, Pearson χ^2 (1, $n = 65$) = .301, $p < 583$.

Table 2
Comparison of Learning Style Between Respondents and National Sample

Learning Style	Middle School Technology Teachers in Virginia	Rank	National Study of Secondary Teachers and Administrators (McCarthy, 1987)	Rank
Imaginative (Type I)	13.9%	2	23.0%	3
Analytic (Type II)	4.6%	4	31.1%	1
Common Sense (Type III)	69.2%	1	17.4%	4
Dynamic (Type IV)	12.3%	3	28.5%	2

To further investigate the first hypothesis, respondents' learning styles were cross-tabulated with their laboratory preference (Table 4). Chi-square analysis revealed that the frequencies for laboratory preference and learning style did not differ significantly from expected values, Pearson χ^2 (1, n = 65) = .046, p < 830.

Table 3
Distribution of Learning Style by Laboratory Environment

	Learning Styles			
	1,2,4[a]		3[b]	
Laboratory Environment	*n*	%	*n*	%
Modular	13	33.3	26	66.7
Conventional	7	26.9	19	73.1

[a] Imaginative, Analytic, and Dynamic Learning Styles
[b] Common Sense Learning Style

Crosstabulation of the learning styles of middle school technology teachers in Virginia by the national findings of McCarthy (1987) showed a significant difference, χ^2 (1, n = 65) = 126.5, p < 001. Table 5 illustrates that the observed frequencies of the technology teachers and the learning styles from the national sample do differ from expected values more than would be expected by chance, Pearson χ^2 (1, n = 65) = 5.885, p < 015.

Table 4
Distribution of Learning Style by Laboratory Preference

	Learning Styles			
Laboratory	1,2,4[a]		3[b]	
Preference	*n*	%	*n*	%
Modular	13	31.7	28	68.3
Conventional	7	29.2	17	70.8

[a] Imaginative, Analytic, and Dynamic Learning Styles
[b] Common Sense Learning Style

Table 5
Comparison of Learning Styles of Respondents to National Sample

Learning Styles	National Learning Styles Study[c]			
of Technology	1,2,4[a]		3[b]	
Teachers in VA	*n*	%	*n*	%
1,2,4[a]	20	100.0	0	0.0
3[b]	34	75.6	11	24.4

[a] Imaginative, Analytic, and Dynamic Learning Styles
[b] Common Sense Learning Style
[c] McCarthy (1987)

Part A of the LTM is used to assess the four learning styles identified by McCarthy (1987). A second section of the LTM measures how individuals process new learning. When new information is obtained, individuals have a predisposition to handle it one of two ways. *Watchers* prefer to engage in subjective introspection before acting on information or experience. People who prefer *Doing* act first and then reflect on their actions. Of the sixty-five respondents only two (3%) were balanced between *watching* and *doing*. Fifty-one percent of respondents (n = 33) preferred to *Watch* and make sense of new learning before acting. The remaining 46% (n = 30) of respondents *Do* when they process new information.

Discussion

The self-perceived learning styles of respondents to this study were significantly different when compared to McCarthy's (1987) findings for secondary teachers and administrators. This demonstrates the uniqueness of the technology teachers in this sample and supports past research concerning technology teachers. Namely, in a national study of ITEA members, Wicklein and Rojewski (1995) used the Keirsey-Bates Temperament Sorter to assess the temperament types of technology teachers. When compared to the general population, technology teachers demonstrated a higher preference for a Sensing-Judgement (SJ) temperament. Individuals with an SJ temperament tend to gather information directly through the five senses and prefer to live in a structured, orderly, and planned fashion.

Of the four learning styles defined by the Learning Type Measure instrument (Imaginative, Analytic, Common Sense, and Dynamic), over sixty-nine percent of the technology teachers in this sample were identified as Common Sense learners. Therefore, these teachers…

- are interested in productivity and competence.
- try to give students the skills they will need to be economically independent in life.
- believe curricula should be geared to this kind of focus.
- see knowledge as enabling students to be capable of making their own way.
- encourage practical applications.
- like technical things and hands-on activities.
- are exacting and seek quality and productivity.
- believe the best way is determined pragmatically.
- use measured rewards.
- tend to be inflexible and self-contained and lack team-work skills (Excel, 1998).

This finding suggests homogeneity among these middle school technology education teachers and supports research reported by Heikkinen, Pettigrew, and Zakrajsek (1985) concerning industrial arts/technology education. They showed that college education majors of different subject matter fields exhibited distinct learning styles. Students majoring in industrial arts demonstrated high preferences for working with things, direct experience, and detail.

An overwhelming majority (84.6%) of modular laboratory teachers in this study indicated that their current laboratory environment was their preferred method for implementing Virginia's middle school technology education curriculum. In a similar finding, Brusic and LaPorte (2000) reported that their sample of modular laboratory teachers thought modular labs allowed them to implement most (60% or more) of the Virginia curriculum, but not nearly all (80% or more) of it. There is clear support among modular laboratory teachers in Virginia that modular laboratories can be used to implement a majority of Virginia's middle school technology education curriculum.

The learning styles of respondents in conventional laboratories were not significantly different from the learning styles of respondents in modular laboratories. Though it seems logical that learning style might explain laboratory preference, this notion was not supported by this study. Perhaps the LTM was not sensitive enough to assess the learning style differences of this sample. Since both conventional and modular laboratory teachers were overwhelmingly Common Sense learners, there might be a range within this particular learning style that was not detected.

Rogers (1998a) suggested that many teacher education programs are not preparing technology teachers for the type of laboratory environment they will typically encounter upon graduation. Hopefully, teacher educators will assess the learning styles of pre-service teachers and help them understand the relationship between learning style and instructional variety. By understanding the concept of instructional variety, pre-service teachers will be prepared for a wide range of teaching environments.

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