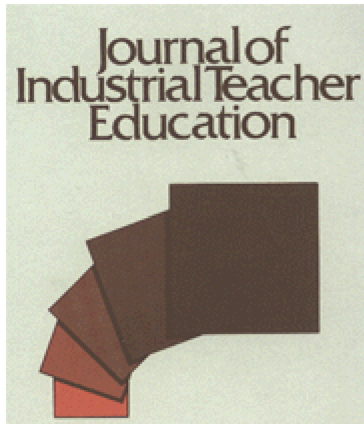

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A Comparison of the Effectiveness of Modular Drafting Instruction versus Contemporary Drafting Instruction on Collegiate Technology Education Students

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Modular technology education (MTE) has grown considerably since the middle of the 1980s (Reed, 2001). According to Weymer (1999), MTE is defined as a curriculum provided by a commercial vendor in which students learn about an area of technology by (a) participating in interactive media presentations, (b) following instructions in workbooks, (c) writing responses in student journals, and (d) experimenting and building projects. With the growth of MTE has come the decline of traditional and contemporary technology education laboratories, but is this curriculum more effective in educating technology education students than the contemporary instruction it is replacing?

According to Weymer (1999), prior to the infusion of MTE, only a few individuals significantly contributed to the development of MTE. These individuals were Pressey, Skinner, and Warner. Pressey and Skinner are known to have developed the first teaching machines (Weymer, 1999). According to Weymer, Warner proposed that technology education (industrial arts) should be taught through a cluster approach, as opposed to a skill-based approach. The MTE approach combined the clusters of Warner and the idea of programmed instruction by Skinner (Gloeckner & Adamson, 1996). Petrina (1993) called MTE "a contemporary manifestation of teaching machine and programmed learning theory of the 1930s-1960s" (p. 73).

Both Potosky (1997) and Evans (1999) referred to Dean as the founder of MTE. In 1989, Dean's company designed the first technology education modules. Evans noted that Dean has done more than any other person to change the face of technology education in the last decade of the 20th century.

Vendors have invested millions of dollars in the research and development of these modules (Gloeckner & Putnam, 1995). Degraw and Smallwood (1997) noted that "in many cases, the source of curriculum has become the module manufacturer rather than the classroom teacher" (p. 19).

Since the explosion of MTE onto the technology education scene in the late 1980s, there has been only minimal research into its effectiveness. Most of these studies have shown that students had positive experiences with MTE, and that these experiences and findings help to paint a picture of its advantages. However, few studies were found to show its effectiveness on student outcomes. The advantages of MTE are found in surveys and studies of students and teachers who have used the curriculum. These studies focus on student perceptions and perspectives of MTE, not on student outcomes.

Degraw and Smallwood (1997) conducted a survey of Kentucky modular technology education teachers. The findings of their survey indicated that 83% of the respondents believed that modular instruction enhances the relationships among mathematics, science, and technology; 79% of the teachers noted that modules reflected current and emerging technologies; and 79% of the respondents indicated that they believed changing to MTE would broaden the scope of technology education.

Brusic and Laporte (2000) surveyed 453 technology education teachers in the State of Virginia, who reported the principal advantage of MTE to be less preparation time and less frequent behavior problems. Principal advantages of MTE to the students listed by the teachers were having a wide range of appeal, more universal skills, and learning current technology. This survey also pointed out that most MTE teachers like the program as well as or better than the program they offered before its implementation. This survey also noted that 25% of Virginia's technology education classrooms were modular.

Harnish, Gierl, and Migotsky (1995) completed an evaluation of two middle-level modular technology laboratories in Illinois. The evaluation team observed the following occurring in both modular laboratory settings: (a) students working as responsible, independent learners across different modules; (b) students frequently engaged in solving real-world problems; and (c) students guided by different educational technology. This study inferred that MTE was the best way to teach middle-level technology education. However, as pointed out by Brusic and Laporte (2000), this study must be viewed with caution, as the vendor that supplied the modules to the middle schools also funded the study.

A study by Gloeckner and Adamson (1996) addressed both the disadvantages and the advantages of MTE. From interviews with MTE teachers, the authors created a list of advantages. The advantages included (a) flexibility without changing entire curriculum, (b) minimal equipment cost for many activities, (c) ability to meet the needs of individual students, (d) exposure to many technical concepts, and (e) clear and concise testing. Once more, these findings are based on subjective perceptions and do not address student outcomes.

Another advantage of MTE, noted by Miller (1996), was the ease of curricular change. Miller studied the transition from a traditional industrial arts program to a modular technology education program in South Dakota's public schools. His findings indicated that schools in which modular instructional delivery systems were used were making a greater transition to technology education than programs in which traditional systems were used. His findings pointed to MTE as an effective means to change a program to technology education.

With this research of the advantages, there seem to be a few advantages that resonate within all studies. First, a majority of students enjoy working in an MTE laboratory. Second, many MTE teachers list fewer behavior problems as a principal advantage to MTE. Finally, the exposure to many different areas of technology is a common advantage. However, the advantages are lacking enough support to claim that MTE is more effective in student outcomes than traditional or contemporary technology education instruction.

Johnston (1986) conducted a study determining the educational effectiveness of student outcomes with MTE. His was the earliest work dealing with modular instruction in technology education. By comparing a conventional high school manufacturing class with a modular approach to manufacturing, his findings revealed that students receiving conventional instruction achieved significantly higher test scores than students who experienced modular instruction.

Building on Johnston's findings, Rogers (2000) conducted a study of 160 seventh-grade students in a Midwest school district. Using a pretest-posttest design, his study investigated whether MTE was more effective with respect to student outcomes than traditional and contemporary technology education classrooms. Rogers's findings concluded that the contemporary technology education laboratories had a significantly higher effect on student outcomes than either the modular or traditional laboratory settings.

Weymer (1999) conducted another study into the effectiveness of MTE. His research looked at variables affecting performance in sixth-grade MTE programs. Weymer's testing of 142 sixth-graders from a Northeastern state contained the following findings: (a) high achievers in modules tended to be males with a preference for independent learning, high verbal ability, and prior knowledge of the subject; (b) low achievers were females with a preference for dependent learning; and (c) laboratory modules discriminated against students because they fail to address individual learning styles.

Weymer's (1999) findings indicated that MTE was not a fair way to teach all students. If students have a predisposed advantage or disadvantage before they even start a module, how can the outcomes of MTE be accurately judged? His research supported concerns expressed by Petrina (1993) related to the inflexible "one size fits all" nature of MTE (p. 77).

Statement of the Problem

The problem examined by this study was the lack of data indicating the effectiveness of MTE related to student learning. Petrina (1993) questioned whether the modular approach to technology education was effective in increasing student learning. MTE lacks quantitative research into the effectiveness related to the student outcomes of this teaching approach (Reed, 2001).

Purpose of the Study

The purpose of this study was to assess the educational effectiveness of MTE at the collegiate level by examining its relationship with student learning and outcomes. The research was intended to help school districts make educationally sound spending decisions related to the delivery of technology education. With little quantitative research into whether MTE is effective, school districts cannot make an informed decision about the future of their technology education programs.

Methodology

This study compared two groups of collegiate students and the attainment of student outcomes relating to MTE and contemporary drafting instruction. Both groups of students spent two two-hour laboratory sessions learning about drafting as part of a technology teacher education course. One group, the control group, received instruction on basic drafting through contemporary instructional methods led by the laboratory instructor. The experimental group received instruction on basic drafting through the use of a self-directed drafting module developed by a commercial vendor.

Using the assumption that the teacher-led students were the control group, the study followed quasi-experimental form, utilizing the pretest-posttest nonequivalent group design (Best & Kahn, 1989). "Because random assignment to experimental and control treatment has not been applied, the equivalence of the groups is not assured" (Best & Kahn, p. 128).

Popham (2001) noted that the traditional pretest-posttest design is the only feasible design for a study with an overall sample size of 20 or fewer. Since the sample size of this study was 30, the split-and-switch form of the pretest-posttest design was employed (Popham). The split-and-switch design calls for "the creation of two forms of a test, somewhat similar in difficulty" (Popham, p. 132).

The independent variables in this research study were (a) prior drafting knowledge, (b) gender, (c) age, and (d) time and day of laboratory session. The dependant variables were the pretest and posttest scores.

Instrumentation

For this study, two tests were designed to assess the standards and benchmarks related to drafting listed in *Standards for Technological Literacy: Content for the Study of Technology* (International Technology Education Association, 2000). A bank of 40 questions was developed for use on both the pretest and the posttest. These 40 questions were stratified, based on cognition levels noted by Bloom (1956). For the creation of these questions, eight questions came from each of the first four levels of Bloom's taxonomy: knowledge, comprehension, application, and analysis. The remaining eight questions were divided between the two higher levels of Bloom's taxonomy, synthesis and evaluation.

To insure content validity of the questions, the bank of test questions was assessed for content validity by two leaders in the technology education profession. These individuals confirmed that only questions that were relevant and correlated with the *Standards for Technological Literacy: Content for the Study of Technology* (International Technology Education Association, 2000) were used in the test instruments.

The data was gathered by two means. The first was a survey of all participants to learn about the independent variables. The second was the pretest and posttest scores. These scores were compared for statistical differences, and the means were compared between the groups. Additional demographic data was collected to identify the individual variables in this study. This data was analyzed by statistical means to examine for differences between the variables.

Population

There were 30 participants in this study, all of whom were technology education majors at a Midwest land-grant university. Of the study participants, 93.3% (n = 28) were male and 6.7% (n = 2) were female. Modular drafting instruction was completed by 17 male students and 1 female student, and 11 male participants and 1 female participant completed the contemporary drafting instruction.

Previous drafting knowledge or experience was indicated by 18 study participants. Of these 18 respondents, 38.9% (*n* = 7) completed the modular instruction, while 61.1% (*n* = 11) completed the contemporary instruction. No previous drafting knowledge or experience was indicated by 12 study participants. Of these 12 respondents, 41.7% (*n* = 5) completed the modular instruction, while 58.3% (*n* = 7) completed the contemporary instruction. Complete demographic information can be seen in Table 1.

Table 1
Demographic Characteristics of the Participants

	Instruction Type	
	Modular	**Contemporary**
Gender		
Male	11	17
Female	1	1
Drafting experience		
Yes	7	11
No	5	7
Age level		
18-21	8	13
22-29	3	2
30-41	1	3
n	12	18

Findings

The results of this study were based on the pretest and posttest scores of 30 technology teacher education majors. The overall mean gain for the MTE students was 4.22 (*SD* = 2.65), while the overall mean gain for the students receiving contemporary instruction was 2.77 (*SD* = 2.71). Using a t-test for independent samples, there was no statistically significant difference between the MTE and contemporary instruction related to drafting (*t* = -1.46, *p* = 0.16) (see Table 2).

Table 2
Overall Gain Between Modular and Contemporary Instruction

	Pretest		**Posttest**		**Gain**			
Group	***M***	***SD***	***M***	***SD***	***M***	***SD***	***t***	***p***
Modular (*n* = 18)	12.39	3.69	16.61	1.56	4.22	2.65	-1.46	0.16
Contemporary (*n* = 12)	13.16	5.17	15.86	3.26	2.77	2.71		

Previous drafting experience was one variable used to compare net gains. The overall gain of students with previous drafting experience in the MTE group (*n* = 11) was 1.59 (*SD* = 2.22), and the contemporary group (*n* = 7) overall mean gain was 2.83 (*SD* = 2.37). There was no significant difference between these two groups (*t* = -1.11, p = 0.29) (see Table 3).

Table 3
Overall Gain of Students With Drafting Experience

	Pretest		Posttest		Gain			
Group	***M***	***SD***	***M***	***SD***	***M***	***SD***	***t***	***p***
Modular (*n* = 11)	14.18	3.42	17.02	1.53	1.59	2.22	-1.11	0.29
Contemporary (*n* = 7)	15.62	3.33	17.10	2.28	2.83	2.37		

The overall mean gain for students without previous drafting experience was 6.41 (*SD* = 1.20) for the MTE participants and 4.42 (*SD* = 2.64) for the students who received contemporary instruction. The t-test for independent samples noted no significant difference between these groups ($t = -1.78$, $p = 0.11$) (see Table 4). These students did achieve more net gain than those with prior drafting experience. The mean gains for the modular students (M = 6.41) and the contemporary students (M = 4.42) were larger than those for students with prior drafting experience.

Table 4
Overall Gain of Students Without Drafting Experience

	Pretest		Posttest		Gain			
Group	***M***	***SD***	***M***	***SD***	***M***	***SD***	***t***	***p***
Modular (*n* = 7)	9.57	1.99	15.98	1.50	6.41	1.20	-1.78	0.11
Contemporary (*n* = 5)	0.72	5.61	14.13	3.88	4.42	2.67		

There was no statistical difference between the student outcomes of the teacher-led instruction on drafting as compared to the MTE drafting instruction. The overall mean posttest score for the MTE group was 83.1% (M = 16.61), while the overall mean posttest score for the contemporary instruction group was 79.3% (M = 15.86). This difference was not strong enough to suggest that MTE instruction was more effective than contemporary instruction. From the data collected by this study, no fact-based conclusion can be derived.

Discussion

The findings from this study led to the recommendation for the need for further study in this area. Since the results were inconclusive, further study would help schools make better education decisions. Several other recommendations would help to further research in this area. This study's recommendations include the following.

- A comprehensive study should be completed at the middle school level because many modular technology education companies target their products for middle - level education.
- A larger sample size would help with the collection of more data. The limited sample size hindered the ability of this research to find a statistically significant difference, and a gender-balanced environment would garner greater results.
- Increased instruction time would be better for both the MTE and contemporary groups.

Another important benefit derived from this research was the concept of studying MTE as related to student outcomes. Much of the research previously completed on MTE had nothing to do with whether students learn more than when using other instructional methods. Only one previous study was identified that investigated student outcomes. More data analyzing this concept will help thousands of school districts across the country by providing factual data to support spending in the area of MTE.

A second benefit from this research is the design of the study. From its root of comparing contemporary instruction to MTE, future studies could be based on the research model that has been used here. Using a middle-school setting, where sample size and gender are not factors that will skew the data, this study design could be replicated with relative ease. The testing instruments have been designed; the demographic data sheets have been constructed; and the methodology has been established. With slight modifications of the pretest-posttest instrument, the design of this research lends itself well to replication by others across the United States.

These benefits have led to the conclusion that this study, though not statistically successful, was a personal success for the researcher. It prepared this future teacher for the classroom, while exposing him to a life of research for his chosen field. It also helped him to gain skills and interests for action research. The researcher feels that surveying and interviewing students is only a start to finding the real solutions to current problems. Systematic research will lead to real-world solutions technology education teachers all across the United States can use.

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