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In an effort to individualize instruction and improve the effectiveness of instructor-learner transactions, education and instructional research has addressed a wide assortment of learner variables and assessed their relationships to instructional methods and environments. Frequently included in this research are analyses of how information is obtained and processed. Identified in the literature alternatively as learning style, cognitive style, or cognitive control, these variables are learner classifications that describe how a student approaches, acquires, processes, and uses information in addressing learning tasks. An individual's specific learning classification conveys his or her preferred approach to learning tasks and charts his or her particular instructional needs.

Adult education has recently seen the development by Conti and Kolody (2004) of a new model for the study and classification of learning preferences, which they call learning strategies. To accompany their model, they created a new assessment instrument named Assessing the Learning Strategies of Adults, or ATLAS. Although learning strategy research using the ATLAS test has appeared in dissertations and other, less formal, research, it has not yet developed a sizeable base in peer-reviewed, published literature. Nevertheless, the ATLAS learning strategies are grounded historically and theoretically in concepts of psychological types and learner differences, and their wider use may provide means for educators to identify learning preferences and may suggest methods for instructors to individualize and strengthen their students' learning experiences.

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While the ATLAS assessment of learning strategies and associated instructional preferences has not yet been applied directly to career and technical education (CTE) students, it has been used in studies of several other non-traditional populations. Aspects of existing ATLAS research that may be of particular interest to career and technical educators are the findings that (a) the distribution of learning strategies of non-traditional students differ from those of the general population, (b) specific strategy types differ in their associated instructional preferences, and (c) knowledge of learners' preferred learning strategies and favored instructional methods improves learning performance.

**Study Purpose**

The purpose of this study was to apply the ATLAS test to identify and describe the learning strategies and the associated instructional preferences of students in CTE programs and to compare these results with those found in previous ATLAS studies of non-traditional learner populations. The study also sought to determine if the ATLAS results for the CTE students were consistent with ATLAS learning strategy theory. In addition the researchers strove to assess the perceived accuracy of the ATLAS classifications. Specifically, the study addressed the following questions:

(1) What are the learning strategies of the CTE students as measured by the ATLAS test?
(2) According to the CTE students, how accurately does the ATLAS test identify their preferred learning strategies?
(3) Do the ATLAS learning strategy distributions of CTE students match those established for the general population and/or those identified in other non-traditional learner populations?
(4) Are certain instructional methods preferred by all the CTE students across all ATLAS learning strategy groups, and, if so, do these preferred methods match those preferred by other non-traditional learners?
(5) Are there differences in instructional method preferences between specific ATLAS learning strategy groups of CTE students, and if so, do they match the

differences identified between the learning strategy groups of other non-traditional learners?

(6) Are the instructional method preferences of the ATLAS learning strategy groups of CTE students consistent with the expectations of the ATLAS theory base?

## Background

*Categorizing Learning Preferences*

The ATLAS system of categorizing learning strategies is grounded in a large body of research on individual differences. Jung (1934-1954) identified basic human psychological types, or archetypes, which formed a theoretical foundation for the separation of individuals into stable groups classified according to combinations of preferred methods of perception and judgment. Later extensions of Jungian theory of human personality groups led to an array of grouping typologies and a variety of assessment instruments. In the 1950s, the Myers-Briggs Type Indicator identified 16 personality types based on specific combinations of four scales identified earlier by Jung (Briggs-Myers & McCaulley, 1985). Later, Keirsey and Bates (1984) brought personality typing closer to educational application by applying the 16 Myers-Briggs types to identify four categories of learning styles, which they used to specify groups of individuals based on the instructional techniques each group consistently preferred across all kinds of learning tasks.

Additional extensions of the concept of human typing and grouping according to learning preferences or to methods of information processing have furthered the study of what has been identified in the literature by a variety of terms. Theorists who categorized individual learner differences in terms of cognition and by how learners perceived and processed information designated the differences they found among learners as "cognitive styles" or "cognitive controls" (Ausburn & Ausburn, 1978). Cognitive style/control has been systematically studied along several dimensions including field independence/ dependence (e.g Witkin, 1950; Witkin, Dyk, Faterson, Goodenough, & Karp, 1962; Witkin, et al., 1954);

reflective/impulsive cognitive tempo (e.g. Kagan, Rosman, Day, Albert, & Phillips, 1964); leveling/sharpening memory assimilation (e.g. Santostefano, 1964); flexible/constricted field control (e.g. Santostefano & Paley, 1964; Stroop, 1935); and visual/haptic perceptual types (e.g. Lowenfeld & Brittain, 1970). Primary characteristics of all the various dimensions of cognitive style/control are relative independence from general intellectual ability, relationship to human behavior and personality variables, development early in childhood, stability over time, and resistance to training and change.

The literature documents two other models which classify individual differences in approaches to learning. Both returned to the term "learning styles" to name their learner variables, and both represent a combination of the original Jungian personality theory framework, the Keirsey typology, and the newer information processing base of the cognitive stylists. The Dunn and Dunn learning styles model posited 21 elements organized into five groups—environmental, emotional, sociological, physical, and psychological—which were then combined in identifiable ways to determine a learning style that persists in an individual across a broad spectrum of learning tasks. (Dunn & Dunn, 1978, 1992).

In contrast to the personality and information processing theories that underlie the Dunn and Dunn model, Kolb based his learning style model and inventory on a theoretical framework of personal experience. Kolb drew from work in experiential learning of Dewey, Lewin, and Piaget, which he tied together with common themes in psychology, philosophy, and physiology. Kolb proposed two sets of polar opposite systems for gathering, organizing, and transforming information based on past experiences. He identified these dichotomies as concrete experience/reflective observation and abstract conceptualization/ active experimentation. Through combinations of these polar pairs, his model identified four distinct learning styles (Kolb, 1984).

Kolb's experiential base gave his learning style categories a theoretical fit and a substantial research record in the field of adult learning. The andragogy model of modern adult learning emphasizes the importance to adults of using and valuing their

past experiences, of becoming self-aware of their own individual ways of knowing and understanding, and of applying this awareness to self-directed life-long learning (Brookfield, 1986; Knowles, 1980, 1990; Knowles, Holton, & Swanson, 1998; Merriam, 2001; Smith, 1982, 1991).

Some adult education theorists have moved away from the Kolb learning style model and adopted a new approach to identify and classify types of adult learners. These theorists apply the term "learning strategies" to their learner classification types. While this model preserves the theory and principle of identifying and describing stable groups of individuals based on their approaches to learning, it also incorporates both the precepts of andragogy developed by Knowles (1980, 1990) and the principles of cognitive theory. The learning strategies typology set out in the work of Conti, Fellenz, and Kolody bases learners' personal learning preferences and choices directly on their previous experiences in undertaking learning tasks (Conti & Kolody, 1995; Fellenz & Conti, 1993). Fellenz and Conti (1989) suggested that these strategies may be manifestations of all the positive and negative experiences that have ever affected individuals as learners. In their recent analysis of instructional methods and techniques for adult learners, Conti and Kolody (2004) defined learning strategies as "those techniques or specialized skills that the learner has developed to use in both formal and informal learning situations." Learning strategies, they stated, are the "behaviors developed by an individual through experiences with learning" that they elect to use to accomplish learning tasks (p. 184). By aligning learning strategies closely to lived experience and human behavior, these definitions ground the strategies model in the principles of both cognitive theory and modern andragogy.

*Learning Strategy versus Learning Style Research*

Under the general label of "learning styles," many studies have investigated the differences in individuals' preferences and capabilities in undertaking learning tasks. While this research has yielded some useful information, it has been hampered by several problems. First, learning styles have been conceptualized, defined, and assessed in numerous ways, making interpretation

and comparisons of results problematic. A second obstacle is the difficulty found in generalizing and applying learning style research. While learning styles have been found to be consistent for individuals across a variety of tasks, research has shown these styles to be related to learning performance only when a learning task requires a specific cognitive process that is limited by a particular learning style (Ausburn & Ausburn, 1978, 2003). This fact is implicit in Cronbach and Snow's Aptitude-Treatment-Interaction (AII) model (Cronbach & Snow, 1977), which is the research methodology frequently used to study the effects of learning styles on learning performance. The AII model focuses on identifying specific interactions between learner characteristics, the nature of a learning task, and the features of an instructional treatment. It acknowledges that the effects of learning styles are not general, but rather are related to specific learning tasks and instructional methods.

In contrast to learning styles studies, learning strategy research has several characteristics that may make it particularly useful for an analysis of the instructional preferences of CTE students. Rather than a broad range of definitions and an assortment of assessment methods, learning strategy theory has a unified theoretical framework and is assessed by means of a single assessment instrument, the ATLAS test, which is both easily administered and interpreted. In addition, recent ATLAS studies with several groups of non-traditional learners offer a basis for same-instrument, direct comparisons of test results with groups of learners similar to CTE students.

Each of the three learning strategy categories identified by the ATLAS test describes a specific set of alternative approaches to learning. These approaches are based on an individual's lived experiences with learning and are applied by the individual to both formal and informal learning tasks and situations (Conti & Kolody, 1995, 2004; Fellenz & Conti, 1993). Since these ATLAS learning strategy categories represent broad, general processes and techniques that are preferred by individuals in all learning situations, they may have direct relationships to all types of learning and thus may offer general instructional usefulness for CTE practitioners. These characteristics of the ATLAS learning strategy model and

assessment instrument contributed to its selection as the vehicle for this current study.

## The Atlas Instrument

*Development*

Arising from corporate sector work on using inventory-type devices in order to gain self-knowledge to improve performance (Blake & Mouton, 1972; Mouton & Blake, 1974, 1984), the ATLAS test of learning strategy is a relatively new, self-administered instrument for assessing learning strategy preferences. As a step in creating a learning instrument to assist adult learners in developing an understanding of their metacognitive self-awareness, the Self-Knowledge Inventory of Lifelong Learning Strategies (SKILLS) test was developed in the early 1990s. Based on Brookfield's (1987) theories, the SKILLS test identified 15 learning strategies representing different combinations of several components of critical thinking: testing assumptions, generating alternatives, and conditional acceptance of general knowledge (Conti & Kolody, 1999). The SKILLS instrument underwent extensive validation and was used successfully in a large body of adult learning strategy research (Fellenzi & Conti, 1993). However, in order to maximize the usefulness of the SKILLS learning strategy model, there was a need for a tool that was less lengthy and complex than the SKILLS test and one which could be administered easily, completed quickly, and used immediately by both learners and facilitators. This need prompted the development of the ATLAS test of learning strategy (Conti & Kolody, 1999).

Because the ATLAS test was derived statistically from the SKILLS model that preceded it, it potentially carried the established validity of its parent instrument. The ATLAS test creators, Conti and Kolody (1999) produced the ATLAS test through an extensive research process. Construct validity for the ATLAS instrument was established by synthesizing the results of the numerous SKILLS studies at the Center for Adult Learning Research at Montana State University. Cluster analysis was used to consolidate these results and to establish the learner groupings identified by SKILLS responses. Following this consolidation, a process of discriminant analysis determined the specific questions

that separated the clusters. This statistical process produced a three-cluster solution with an accuracy of 96.1% in group placements. These three groups formed the conceptual/theoretical basis for the ATLAS model and its three learning strategies.

To establish content validity for the ATLAS test, discriminant analysis was used to determine the differences between the proposed three learning strategy groups. Once these differences were established, the specific wording of items in the ATLAS instrument was based on the exact pattern of learning strategies used by each group. Thus, while the ATLAS test has only a few items, each item was "based on the powerful multivariate procedure of discriminant analysis" (Conti & Kolody, 1999, p. 19).

Criterion-related validity for the ATLAS test was initially established by comparing ATLAS placements to actual group placements using the SKILLS parent instrument. This process indicated a 70% accuracy rate for the ATLAS test in placing respondents in their corresponding SKILLS group. According to Conti and Kolody (1999), on-going research continues in an effort to ascertain the exact ways members of each learning strategy group go about learning and to clarify what things facilitators do that help or hinder them. These studies are expected to lead to review and adjustment of the wording of each ATLAS item to ensure it is "extremely compatible with the comments of the group members" (p. 19).

Test-retest reliability for the ATLAS instrument has not yet been established in either its initial development or in subsequent published research, an omission which currently hampers its general acceptance as a research tool. However, reliability for the ATLAS test has been demonstrated in both dissertations and informal studies that have found strong test-retest coefficients. For example, Ghost Bear (2001) reported reliability as .87, and the present principal investigator has generally found it to be at or above .90 in informal studies.

Feedback from study subjects suggests that the ATLAS results accurately identified their learning preferences (Conti & Kolody, 2004). Both James (2000) and Lively (2001) reported interview support for the perceived accuracy of ATLAS test results, and Ghost Bear (2001) reported that over 90% of her

respondents agreed that their ATLAS category correctly identified their learning strategy. In follow-up studies to the one reported here, Ausburn and Brown (2005b) also found similar levels of perceived ATLAS accuracy with groups of CTE students.

*ATLAS Theory Base*

Conti and Kolody (1999) developed the ATLAS instrument to measure the learning strategies of adults. The ATLAS test can be taken individually or in a group, either online or via a booklet that guides a user through a short series of questions which identify the user's preferred strategy group. The test requires only two or three minutes to complete. From responses to its few simple questions, the ATLAS test classifies a learner into one of three strategy groups based on his or her preferred approach to learning. The three strategy groups are (1) navigators, (2) problem solvers, and (3) engagers. Each strategy group possesses distinct personal characteristics and a well-defined set of methods its members find most effective when approaching and working through learning tasks (Conti and Kolody, 1999).

Studies of adult learners in hybrid online courses (Ausburn , 2004a, 2004b) have demonstrated the existence of the ATLAS learning strategy groups of navigators, problem solvers, and engagers. Conti and Kolody (2004) state that the three ATLAS categories of learning strategies have been observed in a wide variety of groups, both within and outside the United States. They report the categories to be consistent, largely unrelated to demographic variables and personality measures, and transcendent of cultural boundaries. Through extensive study of diverse adult populations, their research has shown that the three ATLAS learning strategy categories have a nearly equal distribution in the general adult population with 36.5% classified as navigators, 31.7% as problem solvers, and 31.8% as engagers (Conti & Kolody, 1999, 2004).

*Navigators.* In addition to establishing the three categories, Conti and Kolody (1999) outlined the associated instructional preferences of each learning strategy type. According to Conti and Kolody, navigators are focused, conscientious, and results-oriented learners who favor efficient

and effective learning through a carefully charted plan. Navigators require and impose order and structure on their learning process. They plan and organize learning activities and favor making logical connections as they learn. They "plan the work and work the plan." Navigators tend to be high-achievers. They generally do not enjoy group work unless they are able to take control. For navigators, emotions play little role in learning; they are able to separate the message from the messenger. They prefer teachers who are well organized and provide clear objectives, schedules, and deadlines. They learn best in logical sequence in controlled classrooms with instructors who provide prompt feedback

*Problem Solvers.* Conti and Kolody (1999) describe problem solvers as critical thinkers who explore a variety of options as they work through a learning activity. Consequently, problem solvers will avoid closure until they investigate an assortment of alternatives. They test assumptions, generate alternate possibilities to create numerous learning options, and are open to conditional acceptance of learning outcomes. Their curiosity, inventiveness, and intuition may sometimes cause them difficulty in making decisions. Problem solvers thrive in learning environments that promote experimentation and hands-on activities. They may find group learning difficult unless they can set the learning pace and do things their own way. They typically do not like multiple-choice tests, which force them to make choices they may be unwilling to make. Problem solvers appreciate deadlines, but prefer to go about learning in an unstructured way. They dislike lectures, favoring a more personalized recounting of information that includes examples and illustrative stories.

*Engagers.* Engagers comprise the only ATLAS group which approaches learning from the affective domain. According to Conti and Kolody (1999), engagers are emotional learners who love to learn and learn with feeling. Because they value relationships, they seek personal identification and a high level of involvement in the learning process. Engagers seek out learning activities that offer them the greatest opportunity for involvement, interaction, and collaboration. They will completely immerse themselves in an activity or project they find rewarding.

Engagers prefer long-term activities that result in a sense of achievement and a perception of personal growth. They recognize the need to have fun and find both joy and personal satisfaction in a job well done. Engagers thrive in group learning environments that involve interaction and collaboration. They are most successful with teachers who focus on learning rather than on formal evaluation and who customize student projects based on individual student interests. Engagers gravitate towards teachers who show a personal interest in them and with whom they can develop an emotional affinity.

*Learning Strategy Distributions among Non-traditional Learners*

While the distribution of the three ATLAS learning strategy groups has been consistent among most adult populations, there are populations for which the picture is quite different. Researchers found that among high school non-completers returning to education (James, 2000), first-generation American community college students (Willyard, 2000), adult learners at a two-year technical college (Massey, 2001), and at-risk urban youths (Shaw, 2004), the ATLAS group distributions differed significantly from that of the general population. The common element among the subjects of these studies is that they all represent non-traditional learners, broadly defined here as youths or adults who, for a variety of reasons, have followed education options outside the typical route of high school directly through to baccalaureate. The studies found that, in contrast to the general population, in these non-traditional populations there was a strong skew in favor of the engager learning strategy. Furthermore, all these studies of non-traditional learners reported that some learning method preferences were common to all three learning strategy groups. At the same time, researchers observed differences between the strategy groups in other learning method preferences which were consistent with the ATLAS theory base.

These findings prompt the question of what results might be found for CTE students on the ATLAS test of learning strategy. Although, no study has as yet related the ATLAS learning strategies directly to students in CTE programs, the similarities between CTE students and non-traditional

populations suggest that inquiry into the ATLAS learning strategy distribution among CTE students may yield similar findings to those for the non-traditional populations.

Whether or not the findings for CTE students prove similar to those for non-traditional populations, information gathered from those findings may provide instructional implications for CTE educators. Studies of individual differences in preferred instructional methods and approaches to learning have shown that student learning benefits from identifying such differences and from using them to customize instruction. Research has indicated that student achievement and motivation generally improve when instruction matches student learning styles (Gee, 1996; Wakefield, 1993). In a meta-analysis of 42 experimental studies undertaken between 1980 and 1990 by 13 different universities, Dunn, Griggs, Olson, Goreman, and Beasley (1995) concluded that there was a positive relationship between students' academic achievement and instruction that matched their learning styles. Specific to the ATLAS test and its identification of learning strategies, D.R. Munday (2002) and W.S. Munday (2002) both found, in a pair of cross-case validation studies, that knowledge of learning strategies by both learners and instructors improved academic performance.

## Study Method and Procedures

*Subjects*

The subjects in this study were 621 CTE students whose instructors were already using the ATLAS instrument as part of their instructional techniques. The students were enrolled in 13 different career and technical programs in the CareerTech system in various locations and schools across Oklahoma. Of the 621 subjects, 617 provided the required ATLAS data and were included in the data analysis. The sample comprised 65% males and 35% females. Forty-five percent were high school students and 55% were adults who were not taking a program for high school credit. While this convenience sample was neither random nor representative of all CareerTech programs in the state, it did offer broad program and demographic coverage. Details of the demographics of the sample are shown in Table 1.

**Table 1**
*Demographics of Sample (N = 617)*

| | *n* | % |
|---|---|---|
| Gender | | |
| Male | 404 | 65% |
| Female | 213 | 35% |
| Age | | |
| High school | 276 | 45% |
| Adult | 334 | 54% |
| Not reported | 7 | 1% |
| Career/Technical Program | | |
| Business and Communications | 77 | 12.5% |
| Carpentry | 15 | 2.5% |
| Welding and HVAC | 47 | 8% |
| Electrical and Industrial Technology | 43 | 7% |
| Drafting | 11 | 2% |
| Licensed Practical Nursing | 31 | 5% |
| Health Science Technologies | 15 | 2.5% |
| Child Care and Early Childhood Development | 37 | 6% |
| Food Services | 76 | 12% |
| Cosmetology | 3 | 0.5% |
| Emergency Services | 155 | 25% |
| Auto Body | 44 | 7% |
| Auto Mechanics | 63 | 10% |

*Instrumentation*

Data for the study were gathered from two instruments: The Assessing the Learning Strategies of Adults (ATLAS) test of learning strategies, and a short questionnaire developed specifically for the study. The questionnaire asked the subjects to identify themselves on several demographic and perception variables, including gender and whether or not they were taking the course for high school credit. Those who were taking the course for high school credit were classified as high school age; those who were not, as adults. The study subjects also indicated on the questionnaire the CareerTech program in which they were enrolled and the ATLAS learning strategy group to which they

belonged. In addition, subjects used a four-point Likert scale to rate their perception of the accuracy of their ATLAS learning strategy placement. Finally, the questionnaire solicited open-ended responses to two questions which asked the students to identify (a) things teachers do that they liked or that helped them learn, and (b) things teachers do that they disliked or that made learning more difficult for them.

*Procedures*

The principal research investigator asked Oklahoma CareerTech teachers who were known to be using the ATLAS instrument if they and their students were willing to participate in the study. Only volunteers were included in the research. The participating CareerTech teachers administered both the ATLAS test and the study questionnaire to their own students in their own classroom settings. The teachers chose whether to use the online or the paper version of the ATLAS instrument. All completed questionnaires were given to the principal investigator for analysis.

A one-sample chi-square test was performed to compare the ATLAS learning strategy distribution found among the CareerTech students to the reported general-population norms for the test. One-sample chi-square tests were also calculated to assess the distribution of ATLAS types within each of the 13 career and technical program areas included in the study.

Analysis of the open-ended data concerning the subjects' teaching-technique likes and dislikes was based on the qualitative constant comparison method of identifying response categories based on key themes. No response categories were set *a prioi;* all categories were established from within the data as they arose naturally from the comments of the participants. The frequency of comments in each response category was tabulated and then further broken down to determine the frequency of comments for each response category within each ATLAS learning strategy group.

## Results and Discussion

*Distribution of Learning Strategies*

Results of the analysis showed that all three ATLAS learning strategy groups were well represented in the sample of CareerTech students. However, a one-sample chi-square test revealed that the distribution of ATLAS types among the CareerTech students ($n$ = 617) was significantly different from the established norms in the general population ($\chi^2$ = 61.28; $df$ = 2; $p$ = .000). Details of the observed ATLAS distribution are reported in Table 2.

**Table 2**
*ATLAS Learning Strategies Distribution of CTE Students (N = 617)*

| Learning Strategy | *n* | Sample % | Normative % |
|---|---|---|---|
| Navigators | 150 | 24.3% | 36.5% |
| Problem Solvers | 187 | 30.3% | 31.7% |
| Engagers | 280 | 45.4% | 31.8% |

As shown in Table 2, the proportion of problem solvers, 30.3% in the CareerTech group, was very similar to the expected norm. However, there were far fewer navigators (24.3%) and far more engagers (45.4%) than in the norm established for the general population. Likewise, a similar distribution, with significantly greater than expected proportions of engagers, was also observed throughout most of the 13 individual career programs represented in the study. A summary of the frequency and chi-square data for the whole sample and for each of the 13 CareerTech programs is presented in Table 3,

*Perceived Accuracy of ATLAS Learning Strategy Classifications*

According to their Likert-scale ratings, the 617 CareerTech students in the study generally felt that the ATLAS test correctly identified their preferred learning strategies. In all, 94% perceived that the ATLAS description of their learning

strategy had some degree of accuracy. Sixteen percent viewed their ATLAS results as very accurate, 45% as accurate, and 33%

**Table 3**

*Chi-Square Comparisons of Sample ATLAS Distributions to Normative Distributions (N=617)*

| Program | $n_{observed}$ | $n_{expected}$ | $\chi^2$ ($df$ = 2) |
|---|---|---|---|
| Entire Sample | 617 | | |
| Navigators | 150 | 225 | |
| Problem Solvers | 187 | 196 | |
| Engagers | 280 | 196 | $\chi^2$=61.28; p=.00* |
| Business and Communications | 77 | | |
| Navigators | 20 | 28 | |
| Problem Solvers | 21 | 24 | |
| Engagers | 36 | 25 | $\chi^2$=7.50; p=.02* |
| Carpentry | 15 | | |
| Navigators | 5 | 5 | |
| Problem Solvers | 1 | 5 | |
| Engagers | 9 | 5 | $\chi^2$=6.40; p=.04*+ |
| Welding and HVAC | 47 | | |
| Navigators | 12 | 17 | |
| Problem Solvers | 15 | 15 | |
| Engagers | 20 | 15 | $\chi^2$=3.14; p=.21 |
| Electrical and Industrial Technology | 43 | | |
| Navigators | 7 | 16 | |
| Problem Solvers | 18 | 13 | |
| Engagers | 18 | 14 | $\chi^2$=8.13; p=.02* |
| Drafting | 11 | | |
| Navigators | 3 | - | |
| Problem Solvers | 3 | - | |
| Engagers | 5 | - | $\chi^2$ not calculated++ |
| Licensed Practical Nursing | 31 | | |
| Navigators | 7 | 11 | |
| Problem Solvers | 8 | 10 | |
| Engagers | 16 | 10 | $\chi^2$=5.45; p=.06** |

**Table 3 continued**

| | | | |
|---|---|---|---|
| Health Science Technologies | 15 | | |
| Navigators | 4 | 5 | |
| Problem Solvers | 10 | 5 | |
| Engagers | 1 | 5 | $\chi^2$=8.40; p=.01**[+†] |
| Child Care and Early Childhood | 37 | | |
| Navigators | 10 | 13 | |
| Problem Solvers | 8 | 12 | |
| Engagers | 19 | 12 | $\chi^2$=6.11; p=.05* |
| Food Services | 76 | | |
| Navigators | 16 | 28 | |
| Problem Solvers | 17 | 24 | |
| Engagers | 43 | 24 | $\chi^2$=22.23; p=.00* |
| Cosmetology | 3 | | |
| Navigators | 1 | - | |
| Problem Solvers | 2 | - | |
| Engagers | 0 | - | $\chi^2$ not calculated[++] |
| Emergency Services | 155 | | |
| Navigators | 37 | 57 | |
| Problem Solvers | 55 | 49 | |
| Engagers | 63 | 49 | $\chi^2$=11.75; p=.00* |
| Auto Body | 44 | | |
| Navigators | 11 | 16 | |
| Problem Solvers | 12 | 14 | |
| Engagers | 21 | 14 | $\chi^2$=5.35; p=.07** |
| Auto Mechanics | 63 | | |
| Navigators | 17 | 23 | |
| Problem Solvers | 17 | 20 | |
| Engagers | 29 | 20 | $\chi^2$=6.06; p=.05* |

*Significant at .05 level
**Significant at .10 level
[+] Cell sizes marginal for $\chi^2$ calculation
[++] Cell sizes too small for $\chi^2$ calculation

† Preponderance of Problem Solvers, not Engagers

as fairly accurate. Only 6% felt it was not very accurate. This finding is consistent with results of previous dissertation studies of the perceived accuracy of the ATLAS test.

*Instructional Method Likes and Dislikes*

The open-ended question asking what things teachers do that the CareerTech students liked or they felt made learning easier or more pleasant drew 802 comments. Of these, 528 (66%) were classifiable through constant comparison methods into six categories or instructional factors. The remaining 274 comments (34%) were unreadable, uninterpretable, unrelated to instructional techniques or unique items with no useful frequency and were therefore omitted from this analysis.

The six instructional factors identified as positive by the CTE students were (1) hands-on instruction ($f$=230; 44% of usable positive comments), (2) clear and thorough explanations ($f$=103; 20% of usable positive comments), (3) use of visual and audio-visual materials ($f$=60; 11% of usable positive comments), (4) sense of humor and making learning fun ($f$=51; 9% of usable positive comments), (5) group activities, interactivity, and class involvement ($f$=47; 9% of usable positive comments), and (6) relating content to real life experiences through anecdotes and stories ($f$=37; 7% of usable positive comments).

All three ATLAS learning strategy groups were equally likely to contribute to these comments and each group contributed comments in a proportion similar to their representation in the sample. Table 4 details the responses of the three ATLAS groups on these six instructional techniques.

Because two instructional factors, hands-on learning (44% of positive responses) and clear/thorough explanations (20% of positive responses), were the instructional techniques mentioned most frequently by students in all three ATLAS learning strategy groups, the preference for these two instructional factors appeared independent of the learning strategies of the CareerTech students. However, as shown in Table 4, there were several differences among the ATLAS learning strategy groups regarding their preferences for other instructional techniques. While these observed differences may have been biased by the

elimination of unclassifiable responses, these differences are nevertheless consistent with the ATLAS theory base.

The study found that the use of audio/visual materials was most important to the CareerTech navigators (18% of positive navigator responses) and least to problem solvers (9% of problem solver positive responses). This finding was unexpected in light of

**Table 4**
*Instructional Methods Preferred/Liked by CTE Students ($N_{students}$ = 617; $N_{responses}$ = 528)*

| Instructional Method | Response | Navigators | Problem Solvers | Engagers | Totals |
|---|---|---|---|---|---|
| Hands-on instruction | frequency | 55 | 82 | 93 | 230 |
| | % of group | 42% | 49% | 40% | |
| | % of total | 24% | 36% | 40% | 44% |
| Clear and thorough explanations | frequency | 30 | 33 | 40 | 103 |
| | % of group | 23% | 20% | 17% | |
| | % of total | 29% | 32% | 39% | 20% |
| Use of visual & audio-visual materials | frequency | 23 | 15 | 22 | 60 |
| | % of group | 18% | 9% | 10% | |
| | % of total | 38% | 25% | 37% | 11% |
| Sense of humor & making learning fun | frequency | 8 | 7 | 36 | 51 |
| | % of group | 6% | 4% | 16% | |
| | % of total | 16% | 14% | 71% | 9% |
| Group activities, interactivity, & class involvement | frequency | 9 | 13 | 25 | 47 |
| | % of group | 7% | 8% | 11% | |
| | % of total | 19% | 28% | 53% | 9% |
| Relating content to real life through anec-dotes & stories | frequency | 6 | 16 | 15 | 37 |
| | % of group | 4% | 10% | 6% | |
| | % of total | 16% | 43% | 41% | 7% |
| Totals | frequency | 131 | 166 | 231 | 528 |
| | % of total | 25% | 31% | 44% | |

problem solvers' assumed affinity for the use of multiple resources and learning options. Ausburn and Brown (2005a) hypothesized that this finding may reflect problem solvers' tendency to seek out information from a variety of sources of their own choosing rather than confining themselves to information from a single source, such as a teacher.

Other patterns that were consistent with the ATLAS construct and theory base also appeared among the ATLAS learning strategy groups of CareerTech students. The engagers identified an instructor's sense of humor and ability to make learning fun as important to their learning and contributed 71% of the total favorable comments received for this instructional factor. When analyzed within each strategy group, an instructors' sense of humor accounted for 16% of the engagers' positive responses compared to only 6% of the navigators' positive responses and 4% of the problem solvers' positive responses. This result seemed consistent with the ATLAS theory base which describes engagers as enjoying learning experiences and seeking a sense of fun. The navigators' contribution of only 16% of the total positive comments towards this instructional factor also accords with the ATLAS theory base which suggests that navigators separate emotions from learning and the learning message from the messenger (Conti & Kolody, 1999). The contribution by the problem solvers of only 14% of the total positive comments about this instructional factor may reflect their greater desire for a learning environment that allows them personal freedom to pursue their own learning choices rather than one featuring a "fun" or charismatic teacher. (Ausburn and Brown, 2005a).

Working in groups and having opportunities for interaction with others were also mentioned frequently by the CareerTech engagers (11% of positive engager responses; 53% of the total favorable comments for this factor), but less often by the problem solvers (8% of positive problem solver responses; 28% of the total favorable comments for this factor) and the navigators (7% of positive navigator comments; 19% of the total favorable comments for this factor). This result is also consistent with the ATLAS theory base which suggests that engagers, who enjoy

sharing their accomplishments and are skilled at networking, will value working in groups. In accord with ATLAS theory, problem solvers, on the other hand, are likely to find group work appealing only if they can take the lead and guide the group to creative solutions. The CareerTech navigators, as ATLAS theory predicts, were the group who least liked working in groups. This fit their ATLAS description as a group that values control and tends to follow a step-by-step, logical path to learning. Consequently, navigators may find group work frustrating and a waste of time. (Conti & Kolody, 1999).

Another result found in the CareerTech study which was also consistent with previous ATLAS research concerned the instructional technique of relating learning content to real life and personal stories. This instructional factor was mentioned most frequently by the CareerTech problem solvers (10% of positive problem solver responses; 43% of the total favorable comments for this factor) and engagers (6% of positive engager responses; 41% of the total favorable comments for this factor) but appeared to be less important to the CareerTech navigators (4% of positive navigator responses; 16% of the favorable responses for this factor). This finding accords with the ATLAS theory explanation that problem solvers value stories and personalized recounting of information as a method of learning. The fact that the CareerTech navigators did not express a strong liking for stories as a method of instruction also agrees with ATLAS theory which depicts navigators as task-oriented and focused on efficiency. ATLAS theory suggests navigators may be put off by stories that they view as irrelevant and pointless (Ausburn & Brown, 2005a; Conti & Kolody, 1999).

The CareerTech students' comments concerning what teachers do that they disliked or they felt made learning harder or less pleasant also revealed some clear patterns. This question drew 645 comments. Of these, 273 (42%) were classifiable through constant comparison methods into five instructional factor categories and were included in this analysis. The remaining 372 (58%) were unreadable, uninterpretable, unrelated to instructional techniques, or unique items with no useful frequency and were therefore omitted from this analysis. Thus, the "disliked techniques" question drew considerably more

responses that were unique or irrelevant than did the "liked techniques" question.

The five clearly identified disliked instructional factors were: (1) failing to provide clear and adequate explanations ($f$=95; 35% of usable negative responses), (2) lecturing without involving students ($f$=73; 27% of usable negative responses), (3) making students sit and read ($f$=66; 24% of usable negative responses), (4) assigning too much homework ($f$=20; 7% of usable negative responses), and (5) reading to students from textbook or other resources ($f$=19; 7% of usable negative responses).

As with the positive instructional factors, the three ATLAS groups of CareerTech students contributed to the negative comments in proportions similar to their representation in the sample. Table 5 details the responses of the three ATLAS groups on the five disliked instructional factors.

The three instructional factors which received the most frequent negative responses were (1) failure to provide clear and adequate explanations, (2) lecturing without involving students, and (3) making students sit and read. These three instructional techniques were mentioned most frequently as negative factors by students in all three of the CareerTech ATLAS groups and thus appeared to be independent of learning strategy. These factors match the students' desire for clear and thorough explanations (see Instructional Method 2, Table 4) and preference for active rather than passive learning (see Instructional Method 5, Table 4).

At the same time, differences between the CareerTech ATLAS learning strategy groups' dislikes also appeared, all of which conformed to the ATLAS theory base. Navigators, who ATLAS theory characterizes as achievement oriented, submitted the fewest negative comments about homework (5% of negative navigator responses; 15% of the total negative responses for this factor) and expressed the least dislike of being read to (2% of negative navigator responses; 5% of the total negative responses for this factor). In contrast, the problem solvers (10% of negative problem solver responses) and the engagers (7% of negative engager responses) provided more comments stating they disliked being read to (47.5% each of the total negative responses for this factor). Engagers also contributed more comments expressing

**Table 5**
*Instructional Methods Disliked by CTE Students*
*($N_{students}$ = 617; $N_{responses}$ = 273)*

| Instructional Method | Response | Navigators | Problem Solvers | Engagers | Totals |
|---|---|---|---|---|---|
| Failure to provide clear & adequate explanations | frequency | 23 | 30 | 42 | 95 |
| | % of group | 39% | 35% | 33% | |
| | % of total | 24% | 32% | 44% | 35% |
| Lecturing without involving students | frequency | 17 | 23 | 33 | 73 |
| | % of group | 29% | 27% | 26% | |
| | % of total | 23% | 32% | 45% | 27% |
| Making students sit and read | frequency | 15 | 18 | 33 | 66 |
| | % of group | 25% | 21% | 26% | |
| | % of total | 23% | 27% | 50% | 24% |
| Assigning too much homework | frequency | 3 | 6 | 11 | 20 |
| | % of group | 5% | 7% | 8% | |
| | % of total | 15% | 30% | 55% | 7% |
| Reading to students from textbooks | frequency | 1 | 9 | 9 | 19 |
| | % of group | 2% | 10% | 7% | |
| | % of total | 5% | 47.5% | 47.5% | 7% |
| Totals | frequency | 59 | 86 | 128 | 273 |
| | % of total | 22% | 31% | 47% | |

their dislike of homework (8% of negative engager responses; 55% of the total negative responses for this factor) as well as a large number of comments indicating a dislike for the solitary activities of sitting and reading (26% of negative engager responses; 50% of the total negative responses for the factor).

This distribution of dislikes over the three learning strategy groups also meshes with the theoretic descriptions of the three learning strategy groups formulated by the ATLAS researchers. Navigators, the ATLAS research suggests, concentrate on learning goals rather than on an instructor's delivery methods. Their emphasis on goals may explain the fewer

negative comments by the CareerTech navigators concerning homework and having instructors read to them. The fact that the CareerTech problem solvers submitted more negative comments about homework and having an instructor read to them corrresponds to the ATLAS researchers finding that this group prefers to explore a wide variety of learning methods and may therefore balk at limited choices imposed by a teacher. The CareerTech engagers' aversion to homework, being read to, and the solitary activity of sitting and reading appears to bolster the ATLAS findings that this group of learners finds it difficult to learn in situations that do not involve them actively and personally (Ausburn & Brown, 2005a; Conti & Kolody, 1999).

## Comparisons with Other ATLAS Studies

*Previous Studies of Similar Populations*

Because no previous studies have used the ATLAS test to specifically examine the learning strategies and instructional preferences of students in state career and technical programs, it was not possible to directly compare the results of the current study to those of other CTE student populations. However, several ATLAS-based studies of relatively similar populations were available for comparison. Using these studies as a comparative basis, the learning strategy distribution and instructional preferences of the CTE students closely resembled those of such non-traditional learners as non-high-school-completers returning to study (James, 2000), students in a two-year technical institute (Massey, 2001), first-generation American higher education students in a community college, (Willyard, 2000), and at-risk urban youths transitioning into adulthood (Shaw, 2004). As in all these studies, the CTE students in the current study were top-heavy with engagers. In addition, the studies of non-traditional students as well as this study of CTE students revealed that, regardless of their learning strategy, the study subjects preferred active and hands-on learning, teachers who care about their students, clear explanations and instructions, and friendly learning environments. Across all learning strategy groups they also reported a strong dislike for passive learning, long lectures, repetitive and restrictive

instruction (such as reading from a book or being read to), and impersonal approaches to teaching.

Specific preference patterns within each of the ATLAS learning strategy groups of the CareerTech study also paralleled some of the patterns reported by James (2000) and Shaw (2004) for the corresponding groups in their respective studies. Similar to the findings of the current study, both James and Shaw identified preferences among navigators for clear and thorough instructions, well organized lessons, and individual rather than group work. Problem solvers in the current as well as in the James and Shaw studies indicated that they liked to have learning method alternatives, freedom to do things their own way, and teachers who used personal examples in their instruction. Engagers in each of these studies indicated they learned best when allowed to learn with groups of people, when working on learning projects that they perceived as useful and worth their time, and when taught by teachers who demonstrated enthusiasm and humor and who treated their students with friendship and respect.

*Follow-up Studies with Oklahoma CTE Students*

Following this study, the authors conducted two additional studies to test the replicability of the current study's finding that engagers dominate the learning strategy distribution of CareerTech students in Oklahoma. Using an identical methodology to that used in this study, Ausburn and Brown (2005b) conducted a pair of field-based "snapshot" analyses of convenience samples provided by Oklahoma CareerTech teachers who were employing the ATLAS model in their instructional programs. In one follow-up study, the subjects consisted of 46 students (43 high schoolers and 3 adults) in a computer science program in a large urban CareerTech center. In this sample, engagers again dominated the ATLAS distribution. Of the 46 students, 15.21% were navigators, 17.39% problem solvers, and 67.40% engagers.

In a second larger and more structured study, Ausburn and Brown obtained ATLAS data on 251 CareerTech students in nine different program areas taught by 15 different instructors across Oklahoma. The results of this second study showed an

ATLAS learning strategy distribution of 26% navigators ($n$ = 66), 27% problem solvers ($n$ = 67), and 47% engagers ($n$ = 118). Once again, this sample's distribution demonstrated the engager bias in the CareerTech students' learning strategy pattern and showed it to be significantly different from the general population norm ($\chi^2$ = 27.22; df = 2; p = .000). This follow-up study also provided additional ATLAS data for the cosmetology area, which had only token representation ($n$ = 3) in the original study. The second follow-up study included 34 cosmetology students of whom 76% were engagers, thus confirming that in this CareerTech program engagers also dominate the learning strategy distribution.

The second of the two follow-up studies also gave credence once again to the perceived accuracy of the learning category placements of the ATLAS test. Of the 251 CareerTech students who participated in the second follow-up study, 204 reported on their perceptions of the accuracy of their assigned ATLAS learning strategy group. A total of 89% ($n$ = 181) rated their placement as having some degree of accuracy. Eighteen percent ($n$ = 37) felt it was very accurate, 46% ($n$ = 94) perceived their placements as accurate, and 25% ($n$ = 50) as fairly accurate. Only 11% ($n$ = 23) rated their learning strategy placement as not very accurate (Ausburn & Brown, 2005b).

## Conclusions and Recommendations

Several conclusions with implications for career and technical education can be drawn from this study and its follow-ups. First, it appears that CTE instructors can expect to find learners with all three ATLAS learning strategies in their classes, and that CTE students have some general instructional likes and dislikes that cut across all ATLAS learning strategy types. This study revealed several conditions and teaching techniques that may enhance the learning environment for CTE students. These include providing CTE students with hands-on learning activities, clear explanations, multiple learning resources, active rather than passive learning, applied learning related to real life experience, meaningful learning assignments and projects, and personal rather than formal learning environments. While many CTE instructors may believe that their students perform best

under these conditions, this study's findings lend empirical support to those informally-held beliefs.

These general instructional preferences also match those reported for other groups of non-traditional learners reported in recent ATLAS-based research. Some broad instructional guidelines appear to emerge from these studies that characterize the best practice of CTE instructors as members of a larger group of educators whose task it is to maximize the learning experiences of students who may not fit the traditional high-school-to-baccalaureate molds.

Although the finding of several general instructional likes and dislikes common to all three ATLAS types may assist CTE instructors in selecting instructional techniques that engage all their students, it would be an error to focus only on these universally-preferred techniques. A look at another finding of the study points out that this would not comprise a complete and effective instructional approach. The study found several variations among navigators, problem solvers, and engagers in their instructional likes and dislikes. These variations were consistent with both the ATLAS theory base and with the findings reported in dissertation studies with other populations of non-traditional learners (James, 2000; Massey, 2001; Willyard, 2000; Shaw, 2004). Previously cited research has indicated that students' motivation and learning performance generally improve when their learning preferences are used to differentiate and personalize instruction. Thus, in order to maximize the learning of all their students, CTE instructors will need to employ specific techniques that appeal to individual ATLAS learning strategy groups as well as general instructional techniques that engage CTE students across all learning strategy types.

To design personalized instruction that fits the preferences of individual ATLAS learning strategy groups will require that CTE teachers understand how each group approaches learning tasks and will necessitate that CTE teachers learn appropriate instructional methods for each group. Since it is the task of CTE teacher educators to equip CTE instructors with such knowledge, this has implications not only for CTE instructors but for CTE teacher education programs as well. The ATLAS learning strategies model could provide CTE teacher

educators with a learning tool to teach CTE instructors how to customize their instructional techniques for each ATLAS learning strategy type.

A key conclusion arising from this study and its follow-ups is that CTE students have a learning strategy distribution characterized by a predominance of the engager learning strategy, a distribution that differs from the general population. While the sampling used in the present study has limitations and raises cautions concerning generalizing its results, the study does corroborate the findings of other research with other non-traditional learner populations. In all of these non-traditional populations, engagers predominate. Taken collectively, this entire group of studies may identify an indicative pattern and suggests that engagers are the type of learner who tend to leave conventional secondary education and traditional higher education and turn instead to career and technical programs and other non-traditional educational options. For this type of learner, active, hands-on, collaborative, applied, and personalized teaching methods are preferable, and an adult education model based on ownership of learning outcomes, self-direction, and an emphasis on life experiences is typically appealing. This style of teaching is often missing in conventional education classrooms and in many courses in traditional higher education. It is, however, commonly found in career and technical education. In fact, such teaching is generally a hallmark of the CTE system. Findings from the current study may reveal some important answers to the questions of what type of learners CTE is most likely to attract and to why and how CTE curriculum and instruction are often more successful in meeting their needs. Results of this study also point to the particular importance for CTE teachers to understand the learning strategy of engagers and the instructional needs and preferences that accompany it.

While this research raises interesting possibilities and implications for CTE teachers, students, and teacher educators, the results must be re-tested and verified through replication and repetition. The researchers recommend further investigation through replication of this study with additional samples of CTE students drawn from a variety of locations and programs in a focused line-of-inquiry series of research. In addition, related

questions should be investigated. These might include identifying the distribution of the ATLAS learning strategies of CTE teachers as well as students; the effects on learning of matching teachers and students based on preferred learning strategy; the effects on teaching and learning of making teachers aware of the ATLAS learning strategies and their instructional implications; the effects of differentiated teaching methods based on students' preferred learning strategies; the effects of training students to recognize and work with peers with different learning strategy preferences; and the effects of training students to be adaptive in their selection and use of learning strategies.

The studies reported and cited here represent a step forward in exploring the learning strategy patterns and instructional method preferences and needs of CTE students. Knowledge of the instructional likes and dislikes of CTE students both within and across all learning strategy groups can serve as guidelines for instructional methods planning and training for teachers in the CTE field. By using the ATLAS model to help design effective instructional practices, CTE instructors and teacher educators may enhance the learning environment for all their students, whether navigators, problem solvers, or engagers.

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