USING INTERACTIVE BLACKBOARD CHATS
TO PROMOTE STUDENT LEARNING IN PHYSICS

Teresa L. Larkin¹, Sarah Irvine Belson² and Dan Budny³

Abstract - The Blackboard Learning System™ is widely used on many college and university campuses today. This paper will explore the use of this system as a teaching and learning tool in introductory physics. Particular emphasis will be placed on the online chat feature available through Blackboard. During the fall 2002 pilot semester, students enrolled in an introductory physics course for non-majors at American University made extensive use of live, interactive, online chats when completing homework assignments. These chats were peer-led and instructor-moderated. A Socratic dialogue approach was utilized to help promote deeper understanding of key topics and concepts. To address, in part, the question of whether deeper understanding was actually achieved, results from the Force Concept Inventory (FCI), a widely used multiple-choice, survey-type instrument to assess student understanding of basic mechanics concepts in physics, was used. Pre-/post-test gains are compared for active participants in the online chats and the class as a whole to help ascertain student understanding. In addition, links to student learning styles are explored to determine whether learning style may be a factor in terms of active participation in the online discussions. Highlights of student perceptions regarding the use of Blackboard technologies, particularly the online chats, will be shared.

Index terms - Assessment, Blackboard technologies, learning style, on-line discussions, student learning.

INTRODUCTION

The brisk changes that continue to occur in modern society, and in academia in particular, suggest that learning must be a continuous process. A growing body of research on adult learners suggests that increased learning gains can be achieved when instruction is designed with students’ learning styles in mind [1]-[6]. In addition, several practitioners within the domain of physics, as well as engineering education, have noted the importance of teaching with learning styles in mind [7]-[14]. Furthermore, attention to learning styles and learner diversity has been shown to increase student interest and motivation to learn.

A growing number of technology-based educational tools currently exist within the domains of science, mathematics, engineering, and technology (SMET) education. In addition, the use of educational technologies, such as distance education strategies, is growing both in and out of the classroom and laboratory. The use of these technologies has the potential to serve as a powerful tool to improve the educational process for students and teachers [15]. Distance Education is instruction that does not constrain the students to be physically present in the same location as the instructor [16]. Historically, Distance Education meant correspondence study. Presently, audio, video, and computer technologies are often more common modes of delivery.

The term Distance Learning is often interchanged with Distance Education. However, this is inaccurate since institutions/instructors control educational delivery while the student is responsible for learning. Distance Learning is the result of Distance Education. Of additional importance is the fact that educational technology is only as good as the content it supports [17]. Research has shown that these technological tools can only be effective in promoting student understanding if used in a pedagogically sound way [18].

The particular population of students that encompasses the focus of this paper is non-science majors taking introductory physics at American University. Most students take this introductory course to satisfy the university’s General Education requirements for graduation. Because the backgrounds and ability levels of this group of students is quite broad-based and diverse, it is anticipated that the teaching and learning strategies to be described in this paper could be adapted for use with other populations of students as well. The underlying message is quite simple - a learning-style approach CAN be successfully applied with ANY population of students.

This paper addresses the critical role that a learning-style approach can play in terms of teaching introductory physics. A detailed overview of the learning-style model used with introductory physics students will be provided. The instructional approach involving online chats using Blackboard technologies will be discussed, in particular as they relate to student learning in physics and student learning styles. Pre-/post-test assessment data collected from the Force Concept Inventory as well as course grades will be presented. A summary of links between student learning styles and this instructional approach will be

¹ Teresa L. Larkin, Department of Computer Science, Audio Technology, and Physics, American University, 4400 Massachusetts Ave. NW, Washington, DC 20016, tlarkin@american.edu
² Sarah Irvine Belson, School of Education, American University, 4400 Massachusetts Ave. NW, Washington, DC 20016, sirvine@american.edu
³ Dan Budny, University of Pittsburgh, budny@pitt.edu

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described. Student perceptions regarding this learning strategy will also be shared. A significant objective of this paper is to illustrate how a non-traditional teaching and learning tool, such as the use of online chats, may lead to enhanced student interest, motivation, and learning.

**DESCRIPTION OF STUDENT POPULATION**

The introductory course for non-science majors at American University in Washington, D.C. is a one-semester, algebra-based course and is entitled *Physics for the Modern World (PMW)*. Topics covered in this course typically include kinematics, Newton’s Laws, conservation of momentum and energy, rotational motion, fluid mechanics, waves, and sound. Although traditional in its content, the course is not taught in a traditional lecture format. Many traditional teaching methodologies have clearly been shown to put students in the role of passive, rather than active, learning [19]. Traditional instructional methods have also been shown to be inadequate in terms of promoting deep learning and long term retention of important physics concepts. Numerous teaching strategies have been developed that serve to better accommodate students’ needs and diverse learning styles [20]. In addition, the course includes strong conceptual and problem solving components.

PMW is a 3-credit course and consists of a lecture and a laboratory component. Students met twice a week for class sessions that are 75 minutes long. On alternate weeks, students met for a two-hour laboratory.

Attention to learning style and learner diversity began on the first day of class and continued throughout the semester. Before a more detailed discussion of the online chats, particularly as they relate to student learning and student learning styles can be outlined, a description of learning style and the learning-style model that was used in PMW will be presented.

**LEARNING STYLE DESCRIBED AND DEFINED**

*What exactly is a learning style?* Several definitions of learning style currently exist. Keefe [21] defined learning style as being characteristic of the cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment. Learning style is a gestalt of combining internal and external operations derived from the individual’s neurobiology, personality, and development reflected in learner behavior. Learning style also represents both inherited characteristics and environmental influences.

Dunn [22] described learning style as “... the way each learner begins to concentrate, process, and retain new and difficult information” (p. 224). She noted that this interaction occurs differently for everyone. Dunn also highlighted that “To identify and assess a person’s learning style, it is important to examine each individual’s multidimensional characteristics in order to determine what will most likely trigger each student’s concentration, maintain it, respond to his or her natural processing style, and cause long-term memory” (p. 224).

Dunn [23] has suggested that the uniqueness of individual learning styles could be thought of as a fingerprint. She said “Everyone has a learning style, but each person’s is different - like our fingerprints which come from each person’s five fingers and look similar in many ways” (p. 27). Interestingly, Sternburg [24] indicated that an individual’s learning style can be compared to her/his ability and is therefore not etched in stone at birth. Dunn [25] further noted that a person’s style can change over time as a result of maturation. Kolb [26] has suggested that “As a result of our hereditary equipment, most people develop learning styles that emphasize some learning abilities over others.” (pp. 76 – 77).

Dunn contended that strong preferences can change only over a period of many years and that preferences tend to be overcome only by high levels of personal motivation. She further asserted that teachers cannot identify students’ styles without the use of appropriate instruments. Assessing an individual’s unique style is vital to the teaching/learning process. A significant number of research studies have shown that students instructed in a classroom environment where individual learning differences are acknowledged and accepted are more receptive and eager to learn new and difficult information [27 – 32]. Dunn also suggested that a match between a student’s style and a teacher’s style will lead to improved student attitudes and higher academic achievement. A description of the Dunn and Dunn learning-style model employed with students enrolled in PMW is given in the next section.

**DESCRIPTION OF THE DUNN AND DUNN LEARNING STYLE MODEL**

Many different learning-style assessment models and instruments are currently available. While there are similarities between models, there are also important differences. DeBello [33] indicated some models are multidimensional, encompassing cognitive, affective, and psychological characteristics, and others are limited to a single variable, most frequently from the cognitive or psychological domain. In particular, DeBello cited that the multidimensional model developed by Dunn and Dunn was one of only three models in existence that were comprehensive and that involved the analysis of many variables. This section will focus on the learning-style model developed by Dunn and Dunn [34] as shown in Figure 1. The associated learning-style assessment instrument developed by Price, Dunn, and Dunn [35] called the Productivity Environmental Preference Survey (PEPS) will also be described.
Price, Dunn, and Dunn suggested that productivity style theorizes that each individual has a biological and developmental set of learning characteristics that are unique. They further suggested that improvements in productivity and learning will come when instruction is provided in a manner that capitalizes on an individual’s learning strengths. As a model, Price, et al. indicated that productivity style embraces several general principles that they state in the form of philosophical assumptions:

1) Most individuals are capable of learning.
2) The learning conditions in which different individuals learn best vary extensively.
3) Individual learning preferences exist and can be measured reliably.
4) Most students are self-motivated to learn when they have the option of using their learning style preferences and experience success.
5) Most teachers can learn to use individual learning styles as a basis for instruction.
6) When selected teachers are not capable of learning to use individuals’ learning styles as a basis for instruction, students can be taught to teach themselves and, thus, bypass their teachers’ styles.
7) Use of individual learning-style strengths as the basis for instruction increases learning and productivity. (pp. 21 -22)

The basic tenet of the Dunns’ model is that individual styles must be assessed, and, if a student is to have the best opportunity to learn, instructional techniques must be used that are congruent with each student’s style. Not all theorists agree with this tenet because they feel it is extreme. Other theorists wrestle with the question of whether we should teach to an individual’s strengths or try to help them develop their weaknesses. The best answer may be both. One of the best ways, especially in large classes, to teach to individual students’ strengths is to use a variety of instructional styles and modes of delivery. The use of online chats offers students an additional as well as non-traditional option as they work to learn key physics content.

The learning style assessment instrument chosen for this study was the Productivity Environmental Preference Survey (PEPS) by Dunn, Dunn, and Price. This instrument was chosen because of its comprehensive nature, and because of the relative ease of assessing students and interpreting the results. The PEPS was developed from the Dunn and Dunn Learning-Style Model and is described in the following section. As Figure 1 shows, the Dunn and Dunn Learning-Style Model is based on five different categories: (1) Environmental, (2) Emotional, (3) Sociological, (4) Physiological, and (5) Psychological. These categories provide the basis for the elements displayed in the feedback profile obtained after student responses to the PEPS have been scored.

The Dunn and Dunn Learning-Style Model has had widespread use with adult learners. However its use in physics education has been quite limited. As a result, the use of this model in physics, as well as in other branches of science and engineering education becomes even more interesting to study.

**The Productivity Environmental Preference Survey (PEPS)**

The PEPS consists of 100 questions on a Likert scale. This instrument uses a standardized scoring system that includes a range from 20 to 80. The scale is further divided into three categories. These categories are referred to here as Low, Middle, and High and are represented in three columns shown in Figure 2 on the next page.

The Low category represents standard scores in the 20 - 39 range; the Middle category scores in the 40 - 59 range; and the High category scores in the 60 - 80 range. Individuals who have scores lower than or equal to 40 or higher than or equal to 60 for a particular element find that variable important when they are working. Individuals who have scores in the Middle category find that their preferences may depend on many factors such as motivation and interest in the particular topic area being studied. Important to note is the fact that motivation and interest can be linked to particular teaching and learning approaches. If a student feels comfortable with and enjoys a certain approach, their motivation to learn can be enhanced.

Looking at one specific example, within the category of the environmental stimulus are the elements of sound, light, temperature and design (formal versus informal seating). The elements within this category are self-explanatory. This category is one that might appear to be challenging to accommodate in the classroom. However, some examples of how learners could accommodate their preferences within this category include bringing a cushion to sit on, sitting away from the windows if dim light is preferred, and bringing a sweater or light jacket and then discarding it as

![FIGURE 1. THE DUNN AND DUNN LEARNING STYLE MODEL](image-url)
need be. In addition, learners can easily satisfy their preferences when working outside of class. In terms of interpretation of scores, a score $\geq 60$ for the element of sound would mean that an individual has a preference for sound while learning new and difficult information. Individuals could accommodate this preference for sound by listening to soft music on a headset. A score $\leq 40$ on the sound element would imply that an individual does not show a preference for sound and thus should work in a quiet environment (using earplugs if necessary). A score in the middle category means an individual might prefer sound at one time, and not at another. In this case, an individual’s preference would depend on other factors such as interest in what is being learned or personal motivation to achieve.

Numerous research studies [36] have documented the reliability and validity of the PEPS. Dunn and Dunn [37] posited that research on their model is more extensive and more thorough than research on many educational topics. As of 2003, research utilizing their model had been conducted at more than 120 institutions of higher education, at all levels K-college, and with students at most levels of academic proficiency, including gifted, average, underachieving, at-risk, dropout, special education, vocational, and industrial art populations [R. Dunn, personal communication, February 9, 2003].

Dunn, et al. [38] performed a meta-analysis of the Dunn and Dunn model of learning style preferences. They reviewed 42 different experimental studies conducted with the model from 1989 to 1990. Their results indicated that, overall, academic achievement of students whose learning styles have been matched could be expected to be about three-fourths of a standard deviation higher than those of students whose learning styles have not been accommodated. Further, when instruction is compatible with students’ learning style preferences, the overall learning process is enhanced.

The following section highlights one instructional approach developed for use with introductory physics students. The underpinnings of the approach are grounded, in part, in the results of current research on learning styles.

**TEACHING AND LEARNING: AN APPROACH TO ENHANCE STUDENT MOTIVATION AND INTEREST**

All students enrolled in *Physics for the Modern World* at American University were given the PEPS at the beginning of the semester. Students received a computerized individual feedback profile approximately one week after that. This profile is similar to a prescription in that it identifies categories (based on the Dunn and Dunn Model) in which students have strong preferences and gives them information as to how to best utilize these strengths. Students were also extended an invitation to visit with the instructor individually regarding their learning-style profiles.

Teaching approaches utilized in the introductory physics course were designed, in part, using the Dunn and Dunn Learning-Style Model. The approach of interest here involves the use of online chats using Blackboard technologies and is described in the following section.

**Interactive Online Chats Using Blackboard Technologies**

A particular teaching approach used with introductory physics students involved the use of live, interactive online chats using Blackboard technologies. This approach was piloted during the fall 2002 semester. The use of online chats allowed students to use other aspects of their learning style preferences in addition to those used in other dimensions of the course. In particular, students satisfied their need to work in a group environment. Since students chose where they wanted to be when they logged into the chats, they simultaneously satisfied their individual preferences in the environmental category. Furthermore, since the instructor participated in the discussions, students...
satisfied their preference to work with an authority figure present. In addition, students made use of writing, in electronic form, as they communicated with their classmates. When offered in a non-threatening fashion, such as with the online chats, writing can serve to help students elicit and confront their misconceptions in physics [39].

The Blackboard Learning System™ [40] is a technology platform aimed at achieving several objectives including:

1) Measuring and improving student performance.
2) Increasing instructor productivity.
4) Delivering distance learning.
5) Supporting lifelong continuing education.
6) Blending the benefits of face-to-face and online learning through the use of hybrid courses.
7) Leveraging technology to enhance institutional competitiveness, applicant selectivity and retention.
8) Providing a platform framework that integrates course and learning management capabilities with an organization’s student information, security, and authentication protocols.
9) Providing a framework for managing an institution’s digital assets and content. (p. 3)

The Blackboard Learning System™ also featured an online environment that has been designed to supplement either traditional learning or distance learning. Through an intuitive interface, instructors manage online environments for teaching and learning using the following utilities:

1) Content Management and Content Sharing.
2) Assessment Management.
3) Gradebook.
4) Collaboration and Communication.
5) Assignment and Portfolio Management. (p. 4)

Blackboard Inc. recently announced the charter release of the Blackboard Learning System ML™ in Brazilian Portuguese [41] in October 2002. The Blackboard Learning System ML™ is a multi-language edition of the company’s market-leading course management system. Other languages available through this system include Chinese, French, German, Japanese, Spanish, and English. In addition, others including Dutch, Italian, and Korean are currently being developed. Thus, the global nature of this learning environment has broad ranging potential for use at the international level as well.

The particular feature to be explored here involves the collaboration and communication utility of Blackboard. During the fall 2002 pilot semester all students in PMW were enrolled in a course-specific Blackboard site. Students had immediate access to course documents such as syllabi and assignments. The instructor communicated with all students by email through the Blackboard site to send reminders, announcements, etc. In addition, the Blackboard site provided a forum for interactive online chats. The chats were similar in nature to AOL Instant Messenger™ (AIM) [42] that is so commonly used by students to chat with their friends on the web. With AIM the chats with friends appear on separate screens. Thus, if a student is chatting with several friends simultaneously, the desktop contains a screen for each person with whom they are chatting. The unique feature of Blackboard is that the instructor and students can chat on a single screen. This feature allowed for a continuous discussion to take place between everyone logged into the chat.

The online chats provided a useful way of allowing for peer-, as well as instructor-given feedback. The online chats have also proven to help students elicit and confront their misconceptions [43]. The most common use of the chats was for the discussion of homework questions. During the semester, chats were routinely scheduled for a day or two prior to the date that a homework assignment would be collected. The chats were typically set up on different days of the week and at different times each week so as to allow more students an opportunity to participate. The chats were not required, but rather were advertised as an additional way for students to get assistance on their homework when they needed it. One feature of Blackboard allowed the instructor to prohibit anonymous postings. Thus, each chat participant was recognized by name. During the chats, students often referred to each other by first name. Rather than posing a threat or intimidating the student participants, this recognition created a very professional working environment for the online chats.

The format of the chats consisted of a student(s) posting a specific question to the group. Other members of the class were then free to jump in and offer the student help and advice. If a student(s) fell off course in the discussion, the instructor offered some guidance and attempted to steer the discussion back on track. Offentimes the instructor made use of Socratic dialogue techniques during the chats.

Hake [44] developed the Socratic Dialogue Inducing (SDI) lab method which combines interactive engagement teaching and learning strategies with various forms of hands-on experiences. The SDI method was the outgrowth of the work of Arnold Arons, one of the pioneers in physics education research [45]. Much of Arons’ work stemmed from studies of cognitive science and often blended ideas from scholars such as Socrates, Plato, Dewey, and Piaget. SDI labs have proven to be an effective way to guide students to a more solid conceptual understanding of Newtonian Mechanics [46]. Hake has suggested that the SDI method might be characterized as “guided construction” rather than “guided discovery” or “inquiry”. Through the online chats the instructor encouraged guided construction by posing frequent, probing questions to the students. The instructor also used the chats to facilitate a “think out loud” protocol in which both the students and the instructor could offer assistance and guidance to a particular student’s question or comment. This strategy appeared to be a very
effective way to assist students in confronting their personal misconceptions about a particular topic or concept.

Typically, anywhere from 2 - 21 students would log into the online chats. However, this number is potentially misleading, as many more students took advantage of the discussions generated during the chats. A unique feature of the Blackboard chats was that they were automatically archived online. This means that a student who was unable or chose not to log in and participate in the live chat, could access the archives at any time. Through informal discussions with students, the instructor determined that a much larger percentage of students were actually taking the time to look at the archives prior to completing their homework assignments. As a result, the quality of the homework papers submitted by many students during the semester was very high in comparison with the quality during previous semesters.

The following section provides a summary of the data collected in this study. In addition to the data gathered to assess student learning, links between instructional approach and learning styles will be shared.

### Assessment of Student Learning

In fall 2002, 113 students (56 females, 57 males) distributed between two lecture sections, were enrolled in the physics course. Of the total number of students in the class, 37 (roughly 33%) actively participated in the online chats. A breakdown by gender reveals that this group consisted of 23 females and 14 males.

By the end of the fall 2002 semester, 13 online chats had been conducted. Of the 37 active participants, the female students participated in an average of three chats while the male students participated in an average of two chats. Of interest is the determination of how participation in the online chats may have contributed to student learning. One measure of student learning was made through the use of the Force Concept Inventory (FCI).

**Force Concept Inventory (FCI)**

A number of assessment tools currently exist in physics education such as the Force Concept Inventory (FCI) [47], a widely used multiple-choice survey-type instrument to assess student understanding of basic mechanics concepts in physics. However, student responses on the FCI and other similarly structured instruments may not necessarily give an accurate picture of students’ true mental models regarding particular concepts in physics. In a recent study using open-ended responses to the traditional FCI questions, Rebello and Zollman found that the distractors used on the FCI did not always reveal students’ conceptual difficulties with a given question [48]. Furthermore, this study showed that when writing was used as an assessment of student learning, the window into students’ understanding became clearer.

Instruments such as the FCI are just one aspect of assessment and evaluation.

All students in the physics course were administered the FCI at the beginning and at the end of the fall 2002 term. The FCI consists of 30 multiple-choice questions that probe for understanding of basic concepts of Newtonian Mechanics in a way that is understandable to the novice who has never taken a physics course, while simultaneously being rigorous enough for someone who has.

Studies conducted by Hake [49] of many physics classes nationally, suggest that an appropriate figure of merit for success on this test is the fraction of possible gain obtained as given in Equation 1:

\[
<g> = \frac{(post-test average)\% - (pre-test average)\%}{(100 - pre-test average)\%} \tag{1}
\]

As reported in Hake’s study of 62 introductory physics courses (N = 6542), 14 "traditional" courses (N = 2084) achieved an average gain of 0.23 ± 0.04, while 48 "interactive engagement" courses (N = 4458) achieved an average gain of 0.48 ± 0.14.

The data in Table I show an average gain of 0.27 for the class as a whole (N = 100). Note that this number reflects the fact that 13 students did not complete both the pre- and post-tests so data were not available for those individuals. Interestingly the average gain for females was significantly lower than the average gain for males.

**TABLE I**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>(&lt;g&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F (N = 52)</td>
<td>9.8 (33%)</td>
<td>14.6 (49%)</td>
<td>.25</td>
</tr>
<tr>
<td>M (N = 48)</td>
<td>12.8 (43%)</td>
<td>18.2 (61%)</td>
<td>.35</td>
</tr>
<tr>
<td>Total (N = 100)</td>
<td>11.2 (37%)</td>
<td>16.3 (54%)</td>
<td>.27</td>
</tr>
</tbody>
</table>

Of interest is to compare the average gains made by the class as a whole to the average gains made by only those students who actively participated in the online chats. As shown in Table II, the average gain for this group (N = 35) was 0.27, which is identical to that for the class as a whole. Note that of the 37 active participants, two students did not complete both the pre- and post-tests so data were not available for those individuals. A gender comparison of scores reveals similar gains to those attained by the class as a whole. From this data it appears that the online discussions did not have a significant impact on student performance on the FCI.

**TABLE II**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>(&lt;g&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F (N = 23)</td>
<td>9.7 (32%)</td>
<td>13.9 (46%)</td>
<td>.22</td>
</tr>
<tr>
<td>M (N = 12)</td>
<td>14.1 (47%)</td>
<td>20.1 (67%)</td>
<td>.35</td>
</tr>
<tr>
<td>Total (N = 35)</td>
<td>11.2 (37%)</td>
<td>16.3 (54%)</td>
<td>.27</td>
</tr>
</tbody>
</table>
While interesting, the results presented for the FCI are only a small aspect of the assessment of student learning. Of additional interest is the comparison of course grades for the class as a whole and for those who actively participated in the chats. This data is presented in Tables III and IV.

**TABLE III**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Average Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>F (N = 56)</td>
<td>2.901</td>
</tr>
<tr>
<td>M (N = 57)</td>
<td>2.700</td>
</tr>
<tr>
<td><strong>Total</strong> (N =113)</td>
<td><strong>2.802</strong></td>
</tr>
</tbody>
</table>

**TABLE IV**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Average Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>F (N = 23)</td>
<td>3.08</td>
</tr>
<tr>
<td>M (N = 14)</td>
<td>3.02</td>
</tr>
<tr>
<td><strong>Total</strong> (N =37)</td>
<td><strong>3.06</strong></td>
</tr>
</tbody>
</table>

The data shown here reveal the fact that while the female students had significantly lower average gains on the FCI, they had slightly higher GPAs than their male counterparts. One might expect the female students to have slightly lower GPAs as well, but the data clearly doesn’t support that idea. Furthermore, a study conducted by McCullough [50] involving non-majors in introductory physics revealed significant gender differences on FCI scores. These differences may be a result of some inherent gender bias in the instrument and may not completely reveal actual understanding of basic mechanics concepts. This point is further supported given that the data suggest that there is no significant difference in the average grade achieved by the males and females who actively participated in the chats.

The data does indicate, however, that the average GPAs of students who actively participated in the chats was slightly higher than for the class as a whole. In particular, the difference is more notable for the male students. These results may indicate that students who are more motivated and are higher achievers, on average, made more frequent use of the online chats. This presumption lends itself to the inspection of the data collected from the learning style assessments.

In terms of individual learning styles it is important to ascertain what factors might serve to motivate students to participate in the online chats. Inspection of the learning style assessment results for the students who did actively participate indicates that these students shared a common preference for learning with an authority figure present. In addition, the assessment results suggest that almost all of these students had middle to high scores on the tactile and visual components of the assessment. The online chats required a great deal of hands-on interaction as the students typed up their responses and questions. In addition, students had to visually interact with the discussion material through the use of their computer screens. Other learning style elements that may have contributed to using the chats are those in the environmental category. Students could choose the type of environment they wished to be in when they logged into the chats. An additional element worthy of further exploration is the time of day element. Because the times for the chats was intentionally varied, this may have encouraged more students to participate. Furthermore, because the chats are archived, all students (active and non-active) had access to the discussions at any time of the day or night. Because the archived information was available day and night, this allowed students to pursue their work through their individual time of day preferences.

**STUDENT PERCEPTIONS OF THE LEARNING APPROACHES**

Student perceptions regarding the learning approach used during this pilot semester were elicited primarily through informal communication between instructor and students as well as from student evaluations of the course. In future semesters, additional forms of assessment of student perceptions, as well as of student learning, will be employed to further ascertain the pedagogical effectiveness of his approach.

In terms of the online chats, many students acknowledged that even if they had not logged into the live chats, they often made use of the archives when they were completing homework assignments. Several students indicated that the live chats, as well as the archived discussions, were so useful that participating was a “no-brainer!” In some cases, students requested a chat, which indicated that they genuinely found them valuable to the learning process.

Inspection of the course evaluations reveals a significant number of students who made use of the online chats. Typical comments from students were that the online chats and the associated archives were enormously helpful to them as they completed their homework assignments. The large number of students who positively commented on the use of Blackboard technologies in the course suggests that many students (both active and non-active participants) made use of the chat feature and/or the archived discussions.

Overall, the results of the informal discussions and course evaluations suggested that students found the online chats beneficial and useful to them in some way. Unique to the chats was the nature of the feedback that the students’ received. With the online chats, feedback predominantly came from students’ peers. This approach provided students with diverse learning styles an alternative venue for learning.
CONCLUSIONS

The use of online chats offered a relatively new avenue through which learners could take an active role in the learning process. Furthermore, the online chats could be viewed as one form of computer-assisted communication that promoted interactive engagement of the learner with the content being studied. In addition, the online chats offered some students a more comfortable environment in which to interact than the traditional large-lecture class. Although students were identified by name during the chats, the instructor worked to be sure that each student was treated respectfully. Students were very comfortable with the fact that their comments could be identified by name and never expressed any discomfort with this concept.

Certainly there are advantages as well as disadvantages associated with any form of computer-mediated instruction. This mode of communication has the potential to offer greater consistency and to enable students to improve their communication skills while engaging in problem-solving activities [51]. In addition, key differences between computer-mediated conversations and face-to-face discussions include: place dependence, time dependence, and structure and richness of communication [52]. If used as an additional learning tool, the online chats can offer students an alternative to traditional instruction and simultaneously appeal to a wider diversity of learning styles [53].

Acknowledgement of students’ individual learning styles played a critical role in the learning process for students enrolled in PMW in fall 2002. Furthermore, the use of formal learning-style assessments provided useful information that benefited the student as well as the instructor. Important to note was the fact that the learning style assessment tool used was not as critical as the actual assessment of learning styles. Through the specific teaching and learning approach that has been described in this paper, the value and importance of adopting a learning-style approach in the classroom has been illustrated. It is the contention of the author that the adoption of a learning-style approach increased student interest and motivation to learn, in part, through the development of alternative learning strategies designed to accommodate an increasingly diverse population of learners. The need to identify individual learning styles through formal assessment has never been more important than it is at present. Instruction responsive to individual learning styles is especially critical as the pool of students who enroll in introductory physics classes becomes more and more diverse.

REFERENCES

[34] Dunn, R. & Dunn, K. 1993. Teaching secondary students through their individual learning styles. Boston, MA: Allyn and Bacon, 39. (Figure 1 reprinted with permission.)
[37] Ref. 34.