Comparing Learning Style to Performance in On-Line Teaching: Impact of Proctored v. Un-Proctored Testing

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Abstract

The purpose of this study was to examine the impact that proctored versus un-proctored testing would have on learning for an on-line content module; and examine the relationship between LASSI variables and learning. A randomized, pre-test/post-test control group design was employed. College students in a pharmacy curriculum, were randomized to two groups utilizing asynchronous, on-line content with a medical terminology module. Group A utilized proctored, on-line testing, while Group B utilized un-proctored on-line testing. Both were given a pre-test and post-test on medical terminology at the beginning and end of a sixteen week semester. The Learning and Study Strategies Inventory was administered to all students. On-line module delivery paired with proctored testing was more effective in promoting learning when compared to on-line module delivery paired with un-proctored testing. The constructs: anxiety, self-testing, attitude/interest and motivation were significant in predicting learning for proctored students. No significant model emerged for un-proctored students.

Internet based course instruction has been advocated as accentuating the "student as worker" and the "teacher as coach" paradigm, shifting the role of instructor to Socratic questioner, resource provider and student motivator (Wegner, Holloway, & Garton, 1999). Course management systems offer the instructor a new mechanism to present content to students, as well as, provide multimedia access, student-student and student-instructor communication (email, discussion, chat) and on-line assessment through quiz features.

On-line quizzing offers the course instructor a means to provide students with ongoing, real-time assessment of learning. Virtual, "instant" grading offers a unique opportunity to truly incorporate testing into the learning process giving students the opportunity to assess their understanding asynchronously. On-line quizzing allows the instructor to integrate self-assessment with content delivery in a fashion that gives students the opportunity to measure their understanding while they are processing content. Incorporating feedback into these quiz questions can provide a valuable and interactive way for students to correct misinterpretations of material.

More daunting is the idea of utilizing on-line quizzes features, not only for student self-assessment, but also for course examination and grading. On-line instruction is often paired with some mechanism to synchronously test students in a proctored setting. The concern is that un-proctored, on-line, asynchronous testing would be compromised by students collaborating without consent of the instructor (McCabe, Trevino, & Butterfield, 2001; Diekhoff et al., 1996; Ferrell & Fergusson, 1993; Green & Saxe, 1992). The absence of supervision has been cited as a factor in influencing cheating behavior

(Genereux & McLeod, 1995; Whitley, 1998; McCabe & Trevino, 1997). This concern is warranted, however there is a paucity of research testing the effectiveness of un-proctored, on-line assessment as a component of web-based courses. Wellman and Marcinkiewicz (2004) conducted a study that compared the effectiveness of self-paced, on-line learning, applied to a learning module on medical terminology, to a book-based delivery. The study also compared the impact of proctored versus un-proctored testing on learning. The data seemed to indicate there are many students who flourish and learn using on-line learning paired with un-proctored, asynchronous testing. However overall, un-proctored, asynchronous testing was less effective than synchronous proctored testing in promoting learning (Wellman & Marcinkiewicz).

When considering the development of on-line course material, faculty must gain an understanding of how student characteristics influence success in on-line learning, while being sensitive to students' perceptions of quality and quantity of instructor interaction (Picciano, 2002). Dutton, Dutton, & Perry (2002) identified unique characteristics of on-line learners in their study of an Internet-based computer programming class. These included age (they tended to be older); non-traditional student status (less likely to be enrolled in traditional degree programs); employment (more likely to be employed); children (more likely to have childcare responsibilities); commute (more likely to have longer commutes to campus); and computer experience (more experienced with computers). This was compared to traditional classroom students who felt face-to-face contact with instructors and fellow students, motivation from class meetings, interaction with advisors, and attending lectures were important components of college classes. Schrum and Hong (2002) identified seven critical dimensions that impact the success of adults who enroll in distance learning. These included tools, technology experience, learning preferences, study habits and skills, goals and purpose, lifestyle factors and personal traits and characteristics.

Loomis (2000) conducted a study of the relationship between students' study and learning styles and performance in an online research methods course. This was done using the Learning and Study Strategies Inventory (LASSI). The LASSI is a 77-item, self-administered questionnaire evaluating 10 constructs including (Weinstein, 1987):

1. Attitude: General attitude and interest in college;
2. Motivation: Diligence, self-discipline and willingness to work hard;
3. Time Management: Use of time-management principles for academic tasks;
4. Academic-Based Anxiety: Degree to which student worries about school and their performance;
5. Concentration: Ability to play close attention to academic tasks;
6. Information Processing: Use of imaginal and verbal elaboration, comprehension monitoring and reasoning;
7. Selecting Main Ideas: Ability to pick out important information for further study;
8. Study Aid Use: Degree to which student uses support techniques or material to help them learn and remember new information;
9. Self-Testing: Reviewing and preparing for classes and tests; and
10. Testing Strategies: Preparing for and taking examinations.

Significant associations were found between performance in the on-line course and attitude, time management, concentration, selecting main ideas and study aids. The author suggested that colleges and departments that had significant commitment to distance education might benefit from offering students the opportunity to test their learning style to better triage students to the proper content delivery.

Background

As part of a curricular revision in the College of Pharmacy, an online self-study content module for medical terminology with asynchronous delivery was created as part of the first year practice skills lab. It was felt that an online instruction module on medical terminology would provide flexibility, meaningful time-on-task using self-tests and practice quizzes, efficiency in managing the feedback and scoring of practice quizzes for a large number of students, and an opportunity to allow students to conduct their learning in a completely asynchronous format. A study of the first year impact of this module indicated that it was as effective as the previous method of self-study, textbook-based instruction (Wellman & Marcinkiewicz, 2004). The results of that study also indicated that students in proctored testing groups behaved differently than their un-proctored counterparts in terms of content page access and practice quiz usage. This change in behavior was associated with lower levels of learning in the proctored quiz group. The overall purpose of this study was to examine the impact that proctored versus un-proctored testing would have on learning and time-on-task as part of an on-line content module. In addition, the study was intended to examine the relationship between the LASSI variables and learning.

Method

Subjects included 117 college students in a Doctor of Pharmacy program. Students were enrolled in a Practice Skills Lab in the first of a four-year program. An instructional module in medical terminology was developed using WebCT. The module began with rules for word construction and the use of prefixes and suffixes. Chapters were then organized according to the human anatomical organ systems (e.g. gastrointestinal, respiratory, cardiovascular, integumentary, eyes, etc.). On-line, practice quizzes, based on multiple-choice questions, were designed for each chapter to give the student the opportunity to test their mastery of the medical terms. The practice quizzes consisted of 5-6 questions that were designed to provide samplings of the complete database of medical terminology questions compiled for each chapter. Corrective feedback was designed into the practice quiz questions and students were able to retake practice quizzes an indefinite number of times. All modules and practice quizzes were available using any Internet-enabled computer (on-campus or off-campus) and the student's secure WebCT login.

Pre-Test

Students completed an unannounced pre-test that was administered in the first week of the semester. The pre-test was proctored and comprised of 40 multiple-choice

questions derived from medical terms that would be covered by online module. Students were informed of the nature and design of the entire project and written consent was obtained. They were informed before taking the pre-test that they would receive an automatic 25 out of 25 score (equivalent to 1/4 of an exam grade for the course) for taking the pre-test in a conscientious fashion, without regard for their actual performance on the pre-test. It was further explained that any indication that they were simply answering in a pattern (e.g. a, b, c, d, c, b a) would result in forfeiture of these points.

All students were given instructions on the use of WebCT and the on-line medical terminology module. Review of chapters and practice quizzes was included. Students were then randomly assigned to one of two groups that varied based on the presence or absence of proctoring. The two groups consisted of :

1. Online self-study with on-line proctored exams. In this case, written instructions were given about the timing of chapters to be studied during the semester. All content was delivered on-line through WebCT. Students were also instructed on the availability and use of chapter practice quizzes that could be taken an unlimited number of times. This group was given two in-class, online, proctored exams covering the assigned chapters that counted toward their grade in the course. Students were assigned a specific time in the computer lab to complete their exams. College faculty verified student identity and supervised their login and completion of each of the two in-class exams.
2. Online self-study with un-proctored exams. In this case, procedures were identical to the first group except that students in this group were given two online un-proctored, class exams, covering the assigned chapters that counted toward their grade in the course Students were given a 24-hour block of time, to complete their exams, which began at the same time that the other group began their proctored exams. Students were instructed that they were on the "honor" system to take the exams on their own without the use of resources; and that they could do so at any web-enabled computer from campus or home using their course login.

Proctored and un-proctored class exams (2 per group) were comprised of 30 multiple-choice questions, derived from the question databases used for the practice quizzes. The time allotted to take each exam was limited to 20 minutes. Students were informed of the nature of the proctored and un-proctored class exams, and that they counted toward their grade in the class. The first of the two exams, covering approximately half of the medical terminology course content, was given in the 8th week of the 16-week semester. The second exam, covering the second half of the material, was given in the 14th week of the 16-week semester. See Figure I for a graphic representation of the study protocol.

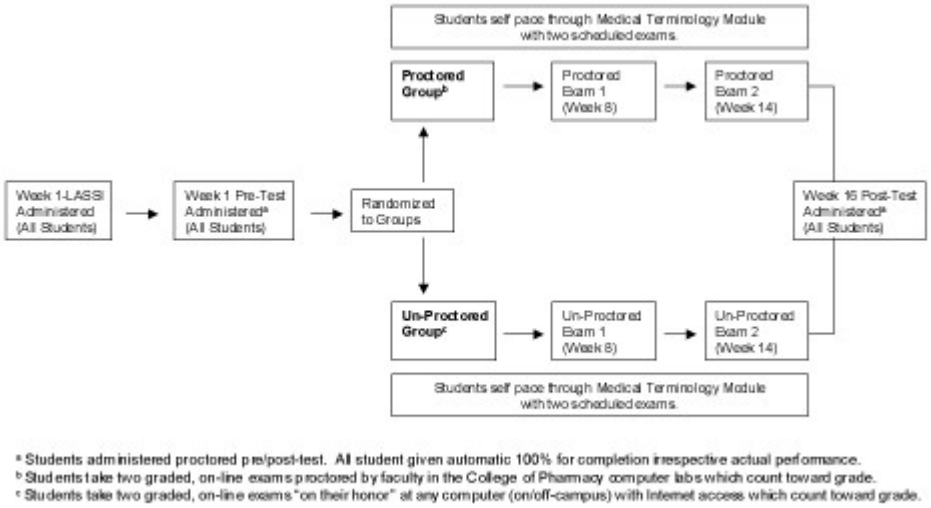


Figure 1. **Study Flow Diagram**

Post-Test

The 40 multiple-choice question, post-test was re-administered in the 16th week. The post-test was "piggy-backed" on to the lab course final exam during its assigned time during final exam week. This allowed for a two-week time-lapse between the last exam and the post-test. Students were informed in the first week that they would be taking a post-test and reminded one-week prior to the post-test. They were told not to study for the post-test, and that they would again be given an automatic 25 out of 25 for conscientiously completing it, without regard for their actual performance on it. Administration of the post-test during "finals" week, along with instructions that their score was "automatically" 100%, was meant to provide sufficient distraction (preparing for other course final exams), and grade assurance (automatic score) to prevent students from studying for the post-test.

The proctored pre and post-tests were scored by hand, to give the course instructor the opportunity to observe any patterned answering. In addition, a few very common medical terms were included, again to signal a student who might be indiscriminately marking answers on the pre and post-test. Raw scores (out of 40) were converted to percentages.

Valenta, Therriault, Dieter, and Mrkek (2001) identified several negative aspects of online learning as it compared to student attitudes and learning styles in distance education programs. One of the aspects identified was that students were reluctant to participate in web-based programs if they experienced technical problems. In this study, students had become acquainted with WebCt in the previous semester therefore; technical problems should have been minimized as an issue when students accessed the medical terminology program.

Learning was defined by change score for the pre/post-test (% post-test minus % pre-test). Time-on-task was defined as content page "hits" and number of attempts at

practice quizzes contained within each chapter. Proctored and un-proctored, as well as practice quiz questions were derived from the same database to maintain a strong association between time-on-task (doing exercises and practice quizzes) and the potential for a higher individual student grade for this part of the course.

Results

Of the 117 students enrolled and pre-tested at the beginning of the semester, and randomized to the two groups, 111 completed the course medical terminology module and post-test. Two students did not complete the semester and 4 students did not give consent to use the LASSI scores. Of students completing the medical terminology module and post-test, 66 were female and 45 were male. The final distribution of usable data was as follows: On-line group with proctored quizzes - 57 responses; and on-line group with un-proctored quizzes - 54 responses (total n = 111). Of the total, females made up 59% (66) of the subjects and males made up 41% (45).

Prior Knowledge

Pharmacy students are required to complete a minimum of two years of "pre-pharmacy", college level coursework in the areas of chemistry, biology, English composition and the humanities. In addition, students must complete the Pharmacy College Admission Test (PCAT), which measures verbal ability, quantitative ability, reading comprehension, and knowledge in biology and chemistry. Groups did not differ on cumulative pre-pharmacy grade point average ($p = 0.296$) or cumulative PCAT score ($p = 0.888$) as tested by independent samples t-test.

Learning

Table I outlines the results of the class quizzes and pre-test/post-test changes score comparing the proctored quiz group to the un-proctored group. Students did not differ on performance on class quizzes 1 ($p = 0.809$) and 2 ($p = 0.986$). Student did, however, differ significantly on learning as defined by improvement from medical terminology pre-test to post-test. Students who received proctoring of in-class, on-line quizzes had more significant improvement in post-test scores (as compared to pre-test) when compared to their un-proctored counterparts ($p = 0.018$). P-values were estimated using t-test for independent samples.

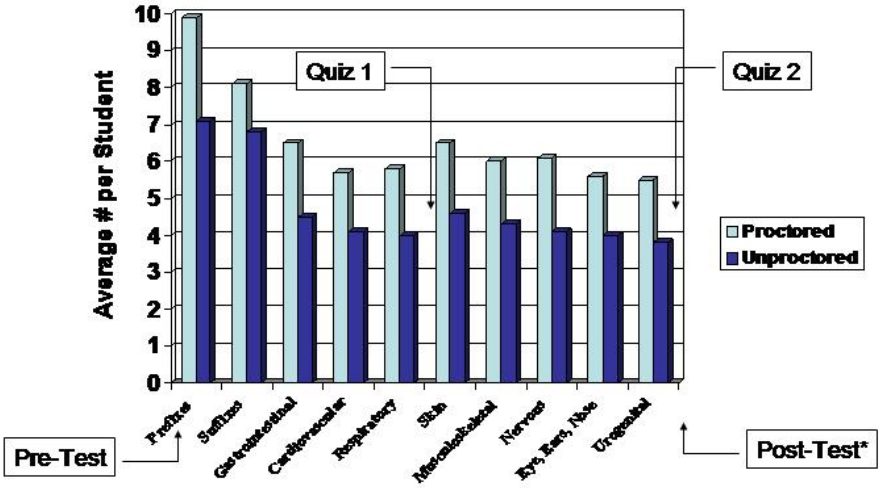
Table 1

Change Score (Pre-Test to Post-Test): Proctored and Un-Proctored Groups

Group	**N**	**Mean Score (out of 30) for Class Quiz 1**	**Mean Score (out of 30) for Class Quiz 2**	**Mean Change Score (± SD) Pre/Post Test**
Proctored Quizzes	57	28.2 ± 2.0	28.4 ± 1.8	**13.65 ± 6.24**
Un-Proctored Quizzes	54	28.3 ± 1.8	28.4 ± 1.7	**10.91 ± 5.71**
p-value		0.809	0.986	**0.018**

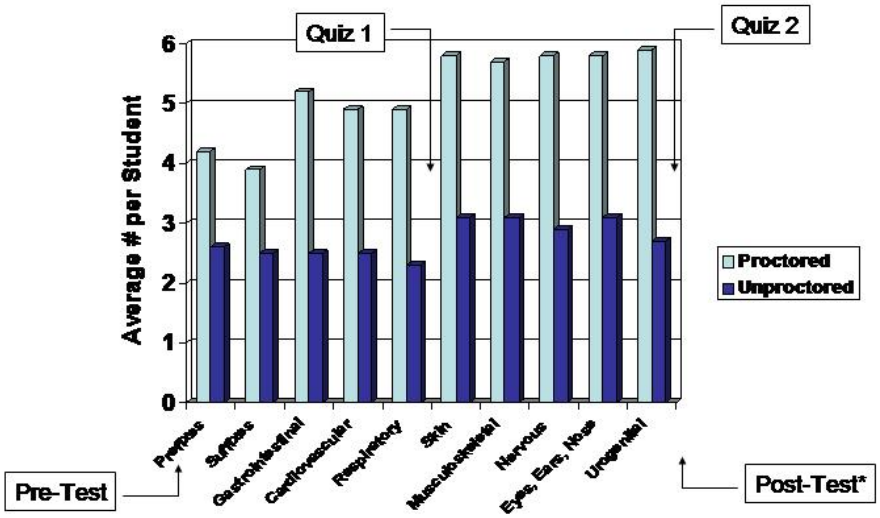
Time-on-task

Figures II and III illustrate the utilization of chapter content (page hits) and practice quizzes, respectively. Students in the proctored quiz group utilized content via direct page hits with greater frequency than their un-proctored counterparts ($p = 0.002$). Proctored students also utilized practice quizzes with greater frequency than un-proctored students ($p = 0.001$). P-values were estimated using t-test for independent samples.



* Two-week delay between Quiz 2 and Post-Test.

Figure 2. **Average Number of Page Hits per Student by Group**



* Two-week delay between Quiz 2 and Post-Test.

Figure 3. **Average Number of Practice Quizzes per Student by Group**

LASSI Score

Table II outlines the LASSI scores for each group. Student groups did not differ on LASSI scores for each of the constructs tested by the questionnaire. Table II included the average score (for both groups) and percentile when compared against the national norms (Weinstein, 1987).

Table 2

Overall Group LASSI Score Comparison

Construct	LASSI Score Proctored	LASSI Un-Proctored	p value	Percentile*
Attitude	32.95	33.54	0.477	60th
Motivation	31.91	31.57	0.693	60th
Time Management	25.30	25.78	0.693	64th
Academic-Based Anxiety	24.98	26.50	0.268	46th
Concentration	27.07	27.59	0.636	62nd
Information Processing	29.26	30.52	0.210	74th
Selecting Main Ideas	18.18	18.65	0.482	52nd
Study Aid Use	25.16	26.72	0.103	63rd
Self-Testing	24.79	25.69	0.360	50th
Testing Strategies	28.96	30.11	0.250	50th

Note. *Percentile ranking against national student norms (14, 15)

In Table III, the univariate correlations (Pearson) are outlined for each group. For proctored students, small correlations with change score were found to be significant for the LASSI variables motivation, time management, school anxiety, concentration, selecting main ideas, self-testing and testing preparation. For un-proctored students, no correlations were found between change score and any of the LASSI variables. Pooled data for both groups yielded statistically significant correlations with the LASSI variables time management, selecting main ideas and self-testing.

Table 3

Univariate Correlations (Pearson) for LASSI Variables for Each Group*

LASSI Variable	Proctored Students	Un-proctored Students	All Students
Attitude/Interest	0.003 (p = 0.983)	-0.058 (p = 0.675)	-0.043 (p = 0.653)
Motivation	**0.287** (p = 0.030)	0.080 (p = 0.564)	0.183 (p = 0.055)
Time Management	**0.262** (p = 0.049)	0.153 (p = 0.269)	**0.199** (p = 0.036)
School Anxiety	**0.316** (p = 0.017)	0.029 (p = 0.833)	0.157 (p = 0.100)
Concentration	**0.304** (p = 0.021)	0.078 (p = 0.576)	0.175 (p = 0.067)
Information Processing	0.115 (p = 0.394)	0.178 (p = 0.197)	0.115 (p = 0.231)
Selecting Main Ideas	**0.302** (p = 0.022)	0.148 (p = 0.286)	**0.213** (p = 0.025)
Use of Support Techniques	0.099 (p = 0.462)	0.055 (p = 0.693)	0.038 (p = 0.693)
Self-Testing	**0.309** (p = 0.019)	0.161 (p = 0.245)	**0.202** (p = 0.033)
Testing Preparation	**0.298** (p = 0.024)	0.028 (p = 0.843)	0.150 (p = 0.115)

Note. *Statistically significant correlations in bold.

Multiple regression analysis was conducted using a step-wise approach to identify significant predictors of change score with consideration of all the LASSI variables. As would be expected from the lack of univariate correlations between LASSI variables and change score for un-proctored students, no significant regression model emerged for this group of students. For proctored students, four LASSI variables emerged as predictive of change score: school anxiety, self-testing, attitude/interest and motivation (Table IV). The combination of these variables explained approximately 33% of the variance in change score for proctored students ($p < 0.001$). Interestingly, when all student data were modeled, selecting main ideas emerged as the significant predictor of change score (Table V); but only explained approximately 5% of the variance in the dependent variable ($p = 0.025$).

Table 4

Multiple Regression Results – Proctored Group (Model $R^2 = 0.334$; $p < 0.001$)

LASSI Variable	Standardized Coefficient	Significance	Tolerance
School Anxiety	0.505	0.001	0.617
Self-Testing	0.296	0.021	0.824
Attitude/Interest	-0.570	0.001	0.490
Motivation	0.296	0.039	0.658

Table 5

Multiple Regression Results – All Students (Model $R^2 = 0.045$; $p = 0.025$)

LASSI Variable	Standardized Coefficient	Significance	Tolerance
Selecting Main Ideas	0.213	0.025	1.000

Discussion

A proctored format to on-line testing proved more effective at promoting learning than independent, un-proctored testing. To assist the reader in interpreting the results of this study, a subgroup analysis was done of the top half and bottom half of each group (proctored and un-proctored). Table VI breaks down the dependent measure (change score) for each of the subgroups. The top half of proctored students performed better in learning than the top half of un-proctored students. In addition, the bottom half of proctored students performed better than the bottom half of un-proctored students.

Table 6

Change Score by Subgroup

	Proctored Group – Top Half	**Proctored Group – Bottom Half**	**Un-Proctored Group – Top Half**	**Un-Proctored Group – Bottom Half**
Change Score*	18.93	8.80	15.31	6.48

Note. *All values statistically significantly difference from each other (p-value range 0.016 to <0.001). Analysis used ANOVA with LSD post-hoc.

Of particular interest was the behavior of the split halves with respect to time-on-task, as measured by page hits and utilization of practice quizzes. Figures IV and V illustrate the progression of time-on-task as the semester evolved. Differences were established using ANOVA with LSD post hoc analysis. Page hits in preparation for class quiz 1 were, for the most part, statistically equal for all groups with students in the lower half of the proctored group occasionally logging in more frequently (GI module $p = 0.018 – 0.009$; respiratory module $p = 0.016$). Practice quiz utilization was predominated by the proctored group, with the student who performed in the lower half utilizing content module based practice quizzes (gastrointestinal, cardiovascular, respiratory) more frequently than either un-proctored group (p values 0.033 – 0.005).

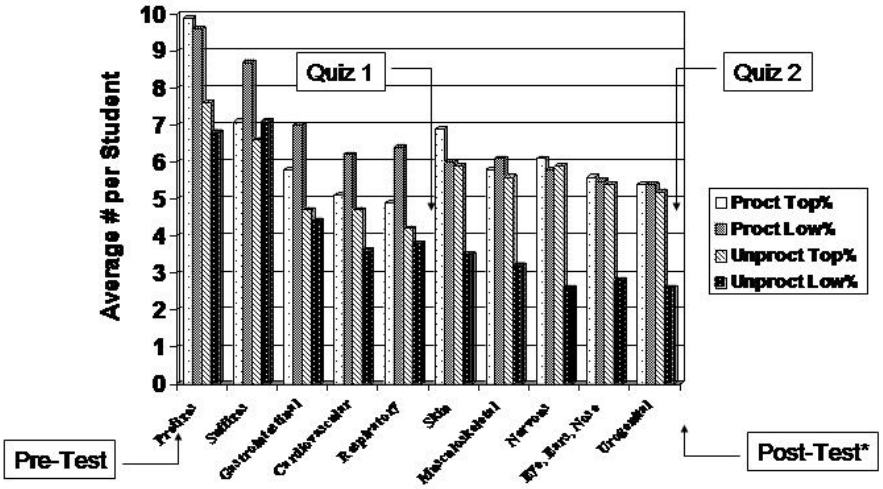


Figure 4. **Average Number of Page Hits per Student by Subgroups**

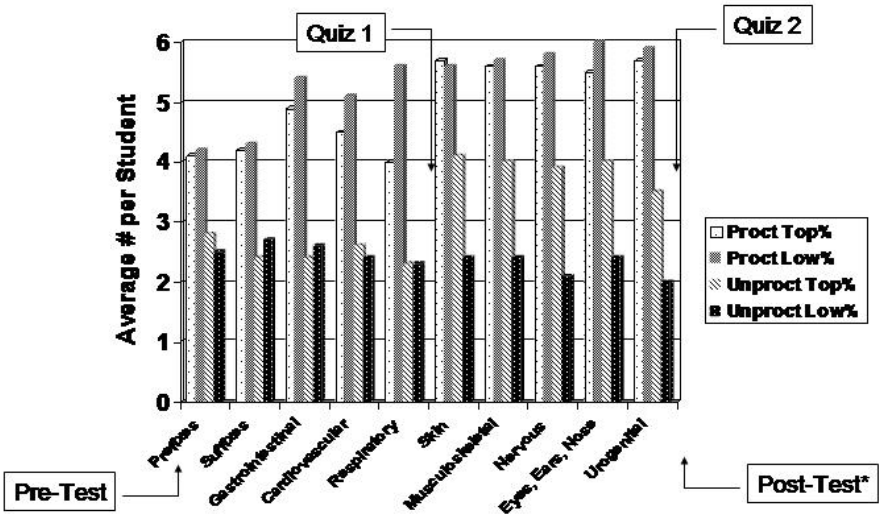


Figure 5. **Average Number of Practice Quizzes by SubGroup**

Following class quiz 1 there was a distinctive alteration in time-on-task. In preparation for class quiz 2 proctored students in the top half and bottom half of performers, and un-proctored students in the top half of performers accessed content pages with equal frequency (p-values 0.996 – 0.312). All three of these groups accessed content pages more frequently than un-proctored students in the bottom half of performers (p-values 0.020 – 0.001). Access of content pages by the top half of both proctored and un-proctored students remained unchanged in preparing for quiz 2 as compared to quiz 1 ($p = 0.297$; $p = 0.949$, respectively). The bottom half of performers in both groups decreased in the number of content page hits ($p = 0.10$ for proctored; $p = 0.045$ for un-proctored).

In preparation for quiz 2, all proctored students accessed practice quizzes more frequently than un-proctored students in the bottom half of performance (p-values 0.007 – 0.001). Un-proctored students in the top half of performers could not be statistically differentiated from proctored students or un-proctored students in the bottom half of performance (p-values 0.218 – 0.078 across 14 of 15 comparisons), with only one exception among quiz 2 chapters ($p = 0.048$ on practice quiz access for uro-genital chapter). Proctored students in the top half of performers increased their use of practice quizzes in preparation for quiz 2 as compared to quiz 1 ($p = 0.013$). Proctored students in the bottom half of performers and un-proctored students in the top half of performers trended up in their use of practice quizzes in preparation for quiz 2, as compared to quiz 1 however, this did not reach statistical significance ($p = 0.067$; $p = 0.064$, respectively). Use of practice quizzes by un-proctored students in the bottom half of performers remained unchanged in preparation for quiz 2 as compared to quiz 1 ($p = 0.626$).

In summary, un-proctored testing, paired with on-line content delivery, was not as effective as proctored testing in promoting learning. In addition, the use of un-proctored testing with on-line content delivery reduced time-on-task for some students, when compared to proctored testing.

A comparison of the significant LASSI variables between this study and the Loomis study are given in Table VII. In this study, attitude/interest, motivation, anxiety regarding school and self-testing abilities were significant predictors of performance in on-line learning when combined with proctored testing. Combined, these variables explained approximately one-third (33%) of the variance in the change score (learning). Since all course content was delivered on-line with only two semester “deadlines” (completion of quiz 1 and 2), a great deal of independent functioning was required of students. As such, it would be expected that attitude and motivation would be an important component of success. Attitude, in the context of the LASSI instrumentation, is intended to measure how clear the students are about their own educational goals and the importance of school (Weinstein, 1987). Since students in this program have gone through a minimum of a two-year pre-pharmacy curriculum and taken a pharmacy school specific aptitude test, it would be expected that they would have a degree of clarity regarding their presence in the curriculum and the importance of the course material in curricular progression. Motivation in this instrument is a measure of the “…degree to which a student accepts responsibility for studying and for their performance…” (Weinstein, 1987). Since on-line learning lacks the structure of weekly classroom attendance, which often drives content “digestion” by the student, motivation should be seen as a key ingredient to success in on-line learning.

Table 7

Learning Styles Components Related to On-Line Learning

LASSI Variable	Loomis Study	Current Study
Attitude/Interest	Related to whether student would drop class.	Predictor of performance in presence of proctored testing.
Motivation		Predictor of performance in presence of proctored testing.
Time Management	Related to overall performance in the class.	
School Anxiety Management		Predictor of performance in presence of proctored testing.
Concentration	Related to non-examination related class performance.	
Information Processing		
Selecting Main Ideas	Related to whether students would drop the class.	Possible predictor of performance.
Use of Support Techniques	Related to non-examination related class performance; examination related performance and overall performance.	
Self-Testing		Predictor of performance in presence of proctored testing.
Testing Preparation		

Anxiety coping or management was a positive predictor of learning in the setting of proctored testing and remained so with consideration of motivation in the final regression model. This needs to be interpreted in light of the scaling of anxiety in the LASSI instrument [14]. Low scores on the LASSI indicate higher degrees of anxiety

regarding their school performance on the part of the student. Higher scores would indicate greater ability at understanding and/or coping with the anxieties of managing course material and test taking. In this case, students who were able to cope and understand their school-related anxiety performed better in an on-line learning environment in the presence of proctored testing.

Finally, self-testing abilities were predictive of performance in an on-line environment. In the case of complete content delivery via an on-line medium, the student must be adept at measuring their ongoing understanding of material as there is no "classroom" setting to signal them. Success of proctored students relative to this ability was validated in this study.

There were no LASSI component variables that correlated with performance in the un-proctored student group. Only one variable (selecting main ideas) was found to correlate with performance when data from both groups was pooled. As discussed previously, there were significant changes in time-on-task behavior for students in the un-proctored study group. The impact of this may be negating the affect that study skills have on performance in this group of students. The results seen in the pooled data are difficult to draw conclusions because the single variable model was only found to explain approximately 5% of the variance in change score. The results for the pooled data model are also affected by the results discussed above related to the un-proctored student group.

Conclusions

In developing the on-line content module for medical terminology, it was our hope that we could deliver both content and assessment in an independent, asynchronous and un-proctored format. The results of this study confirmed those seen in our previous work, and indicate that un-proctored testing, paired with on-line content delivery, was less effective in promoting overall learning and reduced time-on-task for some students. Our hope was that the LASSI learning styles inventory might provide a mechanism to "pre-screen" students who might be better candidates for independent, on-line learning. These results support the idea that there are unique study skills associated with learning for proctored students in on-line learning, however; they provided little clue as to success when paired with un-proctored testing.

In interpreting these data, proctored and un-proctored student groups differed in four key areas that might relate to the results seen (Wellman & Marcinkiewicz, 2004):

1. Supervision: In proctored testing, the instructor provides supervision of student activities that may influence the integrity of the examination process and reduces chances that students might collaborate without consent.
2. Structure: The existence of a "time and place" where an exam will occur is consistent with the experience of most students at this time. This provides a degree of "face validity" and reinforcement of examination process.
3. Environment: Traditional classroom examinations occur at a specific time and location; and provide a synchronicity with other students that may impose a degree of peer pressure or competition to perform that isn't present for on-line test taking.

4. Intra-Test Feedback: The presence of the instructor along side the student provides for technical troubleshooting, should problems occur; as well as allow for clarification of questions the student might have about the assessment instrument.

The study design for this study was insufficient to determine which of these variables may have influenced the results seen here. Future research should be targeted at better understanding these influences. Un-proctored, on-line testing, however; should be approached cautiously addressing the results seen here and the variables above. This should be done in the context of each teacher's own experience.

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