Assessing Learning Across Pedagogical Modalities for Community College Learners in Introductory Psychology

Dominic J. Carbone, Ph.D., Sussex County Community College

Abstract

The present study attempted to explore if learning college level introductory psychology, as defined by the empirically demonstrated mastery of predetermined learning objectives, is as effective in the web-based platform as it is in the traditional setting or web-enhanced classrooms. Data from 149 community college students participating in an introductory psychology course were compared across the three instructional modalities and revealed that those students in the web-based and web-enhanced modalities scored significantly higher on a measure of learning effectiveness than those in the traditional classroom modality. These findings differ from previous studies where no differences were found between the three modalities. The findings are discussed in terms of the benefits of web-based and web-enhanced modalities to force the distributed practice of learning outside of the classroom context for later recognition, recall and application.

The present study attempted to explore if learning college level introductory psychology, as defined by the empirically demonstrated mastery of predetermined learning objectives, is as effective in the web-based platform as it is in the traditional or web-enhanced modalities.

Literature Review

This literature review focuses on the research regarding the comparative effectiveness of the three most common instructional modalities: (1) traditional face-to-face instruction, (2) technology-based instruction, and (3) technology-enhanced or blended instruction. The review focuses on studies concerning samples that were drawn from higher educational settings over the past 30 years. The review will conclude with a rationale for the present study based on the knowledge garnered from prior studies.

Technology Based Versus Enhanced Courses: Potential Concerns & Possible Benefits

First, let us define what is meant by learning using a contemporary definition from the work of Brown, Roediger & McDaniel (2014) who define learning as acquiring knowledge and skills readily available from memory so one can make sense of future problems and
opportunities. The three common modes of instruction are: traditional, technology-based, and technology-enhanced, according to Bernard, Abrami, Lou, Borokhovaski, Wade, and Wozney, (2004). Traditional instruction is defined as face-to-face interaction between students and an instructor that takes place during a specified time period for a specified amount of time. Technology-based instruction involves the use of technology to replace the face-to-face interaction and may be free from the constraints of a predetermined instructional time, as in the case of asynchronous instruction, or synchronous; experienced by the learners and instructor simultaneously. Technology-enhanced instruction combines both traditional face-to-face instruction and elements of technology-based instruction.

Since its inception in the 1980s, technology-based instruction, as compared to more traditional instructional modalities, has had a string of both advocates and critics. Traditional pedagogical theories of learning emphasized Vygotsky’s belief in the socially constructed nature of learning (Vygotsky, 1978), which indicates it essentially involves sharing and negotiation in face-to-face venues whereby social interactions represent the critical criteria in measuring leaning effectiveness. The social constructivist view emphasized the importance of social and collaborative aspects of learning by concluding that individuals learn and achieve academic success through social interactions (Schunk, 2008). For years the traditional model of instruction was widely embraced and accepted as the gold standard for learning.

Technology-based instruction was introduced to be a solution for a variety of issues such as time availability, distance, and restricted course offerings in traditional settings (Clark, 1983; Bernard, Abrami, Lou, Borokhovaski, Wade, and Wozney, 2004). Technology-based instruction is based on the belief that by freeing the learner from the constraints of the traditional classroom they benefit, predicated on the belief that the mode of instruction does not significantly change
effective learning and how it is reliably measured. Galick (1998) voiced concerns about technology introducing an element of instability in learning environments and that online instruction might also threaten to commercialize education, isolate students and faculty, reduce standards, and devalue university degrees. Bernard et al., (2004) cautioned that the issue of instructional quality continues to be a concern since the online delivery modality drastically alters the structural elements of the learning landscape; thereby rendering technology-based instruction limited in that its transfer is not simply a matter of adapting the structures of the traditional classroom environment to that of online environment. They go on to suggest that for instructors to successfully teach online, they need different sets of technical and pedagogical competencies.

More recently, Reisetter, LaPoint & Korcuska (2007) stated that it is less certain that when contrasted with traditional face-to-face delivery, learners acquire the same content as deeply as their online counterparts do. They reflected concerns about the lack of research that demonstrated the viability of online learning as a substitute for traditional modes, taken along with a low completion rate of 50 percent, and thereby called for further studies using outcomes beyond the standard course grades and learner satisfaction to include the “depth of learning” various types of knowledge. Dron, Seidel, & Litten (2004) found the reason most often given for dropping out of online courses was the students' inability to cope with the simultaneous demands of their paid employment and the course. Their preconceptions about the course and their own learning process were at odds with the course demands. They went on to discuss that perhaps because of the students’ perceptions of education, combined with the demands of their employers, many students valued the acquisition of skills and factual information more highly than the processes and struggle of learning that can turn course information into useful
knowledge. So the very aforementioned convenience factors that technology-based learning presented students with might have resulted in introducing education into already overly-scheduled lives, thereby complicating rather than enhancing life.

On a more positive note, Cooper (2001) found that those who chose online courses indeed did so as a matter of convenience, time flexibility, and a desire to avoid the commute to campus. These learners preferred to choose when and how to work, to be personally responsible for their learning, and to determine for themselves how much time they needed to spend on each task to be successful. In this study one third of all learners who were successful in an online course still thought they would have learned more in a traditional setting, suggesting that learners may perceive an inherent quality difference in the two modes of delivery. Jeffcoat-Bartely & Golek (2004) concluded that online learning is especially useful for students who, for reasons of work, family or social commitments, require a different way of learning. Chen, Jones & Moreland (2013) found a large number of studies have yielded mixed conclusions about the efficacy of online courses and went onto state that online instruction offers greater time management flexibility, possibly reduces costs, and generally better fits the lifestyle of many students, explaining the trend toward more online offerings even beyond the college level to the level of professional continuing education.

Hiltz (1994) found that online learning students have more motivation to achieve than traditional students. Given the extra effort perceived to be required for online learning (i.e., mastering the technology of the course), the achievement scores of these students may be the product of higher levels of motivation then in traditional learning settings. The National Education Association (1999) described the novelty effect; the increased interest and motivation among faculty and students simply because they were involved in a new endeavor, thereby
suggesting yet another benefit to technology-based instruction. Reisetter, LaPoint & Korcuska (2007) found that online learners' descriptions of the role and function of the instructor are noteworthy as well. Personality, oral communication skills, and other instructor traits, typically identified as important, were not highly rated by these learners. These findings were consistent with previous research findings (Bernard, et al., 2004; Garrison, 2003; Lindner, Dooley, and Murphy, 2001).

Alonzo-Diaz & Blazquez (2009), in a study aimed at determining possible weaknesses and strengths of each of the two methods with the aim of improving the role of teachers in online and face-to-face learning, concluded that online learning is still in its infancy. Their study focused on the question, "Do differences exist in work-related tasks carried out by teachers of online and face-to-face systems with regard to: (1) theoretical content, (2) practical content-used to understand theoretical material, (3) interaction-relations between students and teachers, and (4) the design-distribution of content and technical problems? They placed an emphasis on course grades as the dependent variable; and similar to other studies, lacked a standardized measure of learning effectiveness. Our discussion now turns to an exploration of why this outcome variable, course grades, might not be useful as a measure of learning and instructional effectiveness and this might explain some of the results of the empirical research comparing various pedagogical modalities.

Technology-Based Versus Technology-Enhanced Courses: Learning Outcomes

The majority of research comparing pedagogical platforms over the past 30 years has consistently revealed that there are no significant differences in learning outcomes between the learning modalities, despite using a variety of measures of learning. Russell (1999) found that there is no significant difference in technology-based and traditional classroom instruction, as
measured by quantitative data such as grades, achievement test scores and learner satisfaction. Johnson, Aragon & Shaik (2000) found that there are no significant differences between the two instructional methods and that students can learn just as effectively in either of the two formats, whatever their style of learning, provided that the teaching is conducted according to adult learning principles and has instructional design guidelines. They also measured student ratings of the instructor, course quality, course interactions, course structure, instructor support, and learning outcomes (i.e., course grades and students self-assessment of their ability to perform various tasks). Yang, Cho, Matthew & Worth (2011) found gender differences in performance between the two modalities whereby males expended more effort than females in online courses while females put more energy than males in face-to-face courses.

One of the first large-scale meta-analysis by Abraham (2002), found no significant difference in learning effectiveness between technology-based learning environments and traditional face-to-face classroom-based learning. In a later meta-analysis, Allen, Mabry, Mattrey, Bourhis, Titsworth and Burrell (2014) found that in the majority of studies in the field to date, the definition of instructional effectiveness was comprised of course grades and routine achievement exams believed to measure mastery of the course material. Ordinarily replicated findings are rarely called into question except that the anecdotal and intuitive experiences of both instructors and students contradict the seeming consistency of such findings. Upon closer inspection, these studies might raise some psychometric concerns over the measurement of the dependent variable; learning. These “no difference” findings might be due to the lack of a methodologically sound construction of an assessment tool designed to measure specific learning objectives and overall learning effectiveness.

Rationale for Current Study
The present study differs from past endeavors in the following important ways: (1) it attempted to explore different pedagogical platforms starting with the most basic level of the higher educational hierarchy; a community college sample. This type of a sample allowed for the investigation of learning in a truly transitional group in the earliest stages of higher education, (2) it compares students across three different pedagogical platforms under closely matched extraneous conditions, (3) it attempted to empirically develop an assessment instrument that measures the effective learning of specific learning objectives, (4) the research questions were developed from a pragmatic perspective based on conversations with educators and administrators, such that the results of this study will impact assessment, academic advisement, course planning and future studies of higher-level courses.

Hypothesis

Based on the literature review and in keeping with prior empirical findings, it is expected that no significant difference should be found in overall learning effectiveness between technology-based versus technology-enhanced versus traditional face-to-face courses.

Methodology

Course Content & Organization

The present study was undertaken during the fall 2014 and winter 2015 semesters, drawing data from a beginning-level psychology survey course aimed at teaching students a set of ten predetermined learning objectives. These learning objectives were the focus of lecture on the history of psychology, theories of personality, sensation and perception, states of consciousness, brain and behavior, research methods and ethical considerations, perspectives on human behavior, human development across the lifespan, social psychology, abnormal development and psychotherapy. This course is offered in both semesters in all three of the aforementioned pedagogical formats.
In its traditional format, the fall semester course was taught during a 15-week period with two 75-minute lectures per week. There was a required textbook, reading assignments, video programs and in-class examinations. The two weekly lectures were delivered in the traditional style with short lecture and discussion periods based upon carefully prepared examples that illustrated key concepts. In the technology-based sections, the course was taught using the WebStudy course management system. Students logged on and began a 15-week semester for fall and 3-week semester for winter, whereby they followed a timeline that included reading material, discussion board forums, examinations, videos and ancillary readings that supported the readings assigned from the textbook. Students were given feedback from the instructor via e-mail and comments were made on their assignments. Students monitored their grades using the grade book option of WebStudy and had access to the class materials at any time.

In the technology-enhanced (blended) format, the traditional delivery of the course was supplemented by providing students with access to all lecture material, interactive textbook modules, video programs, homework and examinations. Web-based courses assignments and solutions, self-diagnostic quizzes, study guides, lecture notes, and discussion boards are all accessible in the blended model. The students in the web-based group, were taught by the same instructor, used the same online resources, covered the same lecture material, submitted the same homework and project assignments, and took the same exams as their on-campus counterparts. Two additional instructors participated in the study by delivering traditional and web-based classes.

**Instrument Development: Learning Objective Assessment (LOI)**

To measure the dependent variable in this study an instrument was constructed to measure ten distinct learning objectives. The instrument was constructed using multiple-choice
items from a test bank provided by the textbook publisher. For this research on introductory psychology material, a test bank from Myers' *Exploring Psychology* (2009) was used. The items were selected by the researcher to measure the retention of learning for the ten learning objectives. The items were embedded in examinations throughout the semester in introductory psychology courses during a piloting phase over a 4-year period of time (8 semesters). Once the pilot phase was concluded, those items with 50 percent difficulty, such that half-the sample passed while half the sample failed the item, were compiled into a cumulative final examination for the present study. These items would not appear in any prior exam that students in the present study would take during the semester. The learning objective instrument (LOI) contained items designed to measure each of the ten learning objectives. The LOI was analyzed to determine reliability using a procedure that yielded a Cronbach’s Alpha. The results indicated that this scale was a reliable measure of learning effectiveness (X=48.3; SD=13.9; Alpha= .95).

**Descriptive Measures of the Sample**

1. *Demographic Variables* such as race, gender and major were also assessed using standard forced choice categories.

2. *Motivation* was measured to determine the student’s reason for taking the introductory psychology class. Students were asked: "Which best describes your main reason for taking this class?" and asked to choose from five possible choices, each reflecting either an intrinsic (i.e., "I am a psychology major" or "It is not required but I am interested in Psychology", extrinsic (i.e., "It is required by my major, but I am not a psychology major") or neutral (i.e., "It is neither required by my major or of interest to me" or "It fit nicely into my schedule") motivation for taking the class.
3. **Motivation for Modality Choice** - Students were asked to articulate their main reason for self-selecting into one of the three modalities. These responses fell into five categories: (1) for reasons of distance from campus; (2) curiosity regarding online learning; (3) for metacognitive reasons; (4) they heard negative things about online courses; or (5) for non-specific reasons.

4. **Previous Online Experiences** was defined as the amount of prior online courses that the student had taken prior to the present course and their reported general satisfaction level with such courses. *Quantity* was assessed by asking subjects to report the exact number of prior online courses that they have taken.

5. **Previous Face-to-Face Experiences** was defined as the amount of prior traditional courses that the student had taken prior to the present course and their reported general satisfaction level with such courses. *Quantity* was assessed by asking subjects to report the exact number of prior traditional courses that they have taken.

6. **Number of Semesters at College** was assessed to determine the subjects' level of familiarity with higher education. Subjects were asked to simply report the number of semesters that they previously experienced at the college level.

**Results**

**Description of Sample**

The total sample consisted of 149, two-year community college students enrolled in an introductory psychology class (See Table 1). Fifty-two were enrolled in the technology-based online section, 46 were enrolled in the traditional face-to-face section, and 51 were enrolled in the technology-enhanced (blended) section of “Introductory Psychology”. One-hundred and twenty-one students took the class during the fall semester, while 28 students took the class during the winter semester as a 21-day web-based course.
Table 1: Demographic Profile of the Sample (N=149)

<table>
<thead>
<tr>
<th></th>
<th>Web-Based</th>
<th>Web-Enhanced</th>
<th>Traditional</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrollment</td>
<td>52</td>
<td>51</td>
<td>46</td>
<td>149</td>
</tr>
<tr>
<td>Age</td>
<td>X=22, SD=6.4</td>
<td>X=20.0, SD=5.1</td>
<td>X=19.7, SD=3.1</td>
<td>X=21, SD=5</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>N=16 (31%)</td>
<td>N=28 (55%)</td>
<td>N=22 (48%)</td>
<td>N=66 (44%)</td>
</tr>
<tr>
<td>Females</td>
<td>N=33 (64%)</td>
<td>N=23 (45%)</td>
<td>N=24 (52%)</td>
<td>N=80 (54%)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>N=38 (73%)</td>
<td>N=41 (80%)</td>
<td>N=35 (78%)</td>
<td>N=115 (77%)</td>
</tr>
<tr>
<td>Black</td>
<td>N=1 (2%)</td>
<td>N=1 (2%)</td>
<td>N=3 (7%)</td>
<td>N=5 (3%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>N=6 (2%)</td>
<td>N=3 (6%)</td>
<td>N=4 (9%)</td>
<td>N=13 (9%)</td>
</tr>
<tr>
<td>Asian</td>
<td>N=2 (2%)</td>
<td>N=3 (6%)</td>
<td>N=3 (7%)</td>
<td>N=8 (2%)</td>
</tr>
<tr>
<td>Am-Ind</td>
<td>N=2 (2%)</td>
<td>N=1 (2%)</td>
<td>N=0</td>
<td>N=3 (2%)</td>
</tr>
<tr>
<td>Other</td>
<td>N=3 (6%)</td>
<td>N=2 (3%)</td>
<td>N=0</td>
<td>N=5 (3%)</td>
</tr>
</tbody>
</table>

The demographic profile of the sample indicated that the overwhelming majority of the sample, across all instructional modalities, was comprised of traditional-age college students. In terms of gender, while the overall sample reflected the expected distribution of males to females, twice as many females chose the web-based format than males. This difference was not statistically significant as measured by a Pearson Chi-Square test (ChiSq=5.1; df=2, p<.075). In terms of ethnicity, the sample was almost exclusively White-Caucasian. The vast majority of the sample (88%), were not psychology majors; whereas the rest either were majors (3%) or were undecided (5%). An academic description of the sample is presented in Table 2.

Table 2: Academic Profile of the Sample (N=149)

<table>
<thead>
<tr>
<th></th>
<th>Web-Based</th>
<th>Web-Enhanced</th>
<th>Traditional</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrollment</td>
<td>52</td>
<td>51</td>
<td>46</td>
<td>149</td>
</tr>
<tr>
<td>Semesters</td>
<td>X=2, SD=2</td>
<td>X=1, SD=1</td>
<td>X=1, SD=1</td>
<td>X=2, SD=2</td>
</tr>
<tr>
<td>Tot. Courses</td>
<td>X=7, SD=6</td>
<td>X=4, SD=6</td>
<td>X=5, SD=6</td>
<td>X=5, SD=6</td>
</tr>
</tbody>
</table>
The academic profile of the sample indicated that the sample was fairly new to the college experience in general and slightly more experienced with web-enhanced and traditional modalities than web-based instruction. The overwhelming majority of the sample took the course because it was required while not being psychology majors (63%), whereas a smaller part took the course out of primarily an interest in psychology (20%), while an even smaller number were required to take the course as part of the psychology major (9%). The smallest amount took the course because it fit into their schedule. In the sample the Motivation for Web-Based Course Selection, was reported to be for non-specific reasons by more than 50% of the sample. The reported Motivation for Traditional Course Selection, was reported to be for metacognitive reasons and a dislike of web-based courses by over 80% of the sample.

Hypothesis Testing
Using a one-way ANOVA, significant differences were found in overall learning effectiveness between technology-based versus technology-enhanced versus traditional face-to-face courses (F=165.7; p<.000). A Tukey HSD post-hoc test revealed that the Web-based group performed best (X=57.9; N=43), followed by the Web-enhanced group (X=55.3; N=36), and then the Traditional group (X=31.7; N=40). Therefore the hypothesis predicting that there would be no significant difference between the three modalities on learning effectiveness is rejected. The present findings suggest that the web-based and web-enhanced modalities yielded significantly higher learning effectiveness scores than the traditional modality.

Discussion
The explanation for the differences in the mean scores on the LOI may reside in any one or combination of the following factors: (1) the modality, (2) the students, (3) the nature of the material in introductory psychology, or (4) in the way that learning effectiveness was assessed in the study. Each explanation will be considered.

The first and simplest explanation of the findings is that web-based and web-enhanced instruction is a more effective way of teaching the learning objectives associated with this introductory psychology course. This may be due to the structural design of the web-based and web-enhanced courses. When contrasted with the traditional mode of instructional delivery, these other modalities provide the learners with a structure for distributed, rather than mass, practice. The context for learning is presented as a self-directed pursuit of engaging the course material in an innovative platform beyond the traditional classroom setting. Perhaps many learners in the traditional modality see the learning process as ending when the class period ends. Online assignments provide them with another way to engage the content of the course. The discussion forums give students a chance to participate in interactions with peers and the professor in a contemporary format that is identical to the way that they interact in other domains of their lives. Additionally, the dis-inhibition effect present in online communication may serve students who might be reticent to participate in a face-to-face discussion. This participation may further serve the student in learning the material. Could the online modality provide learners with not only knowledge but with the incidental acquisition of cognitive skills?

Reisetter, LaPoint & Korcuska (2007) found that online learners believed that they developed self-regulation skills including time management, self-discipline, independence, effective use of resources, and problem solving. They learned to recognize their preferred cognitive modes and to make use of optimal learning times to process content and expected that
most of their learning would be independent. One study by Chappell, Rhodes, Solomon, Tenant, and Yates (2003), found that the need for personal change fuels and organizes adult learning and might serve in the learners' search for "technologies of the self". These would include such metacognitive skills as: self-knowledge, self-control, self-care and self-creation. These skills may be used to promote change and adult learners are likely to prefer learning environments, online or traditional, that they perceive will assist them with their personal identity development and proved a good fit with and/or development of their self-technologies (i.e., time management). Could the online modality force instructors to gain competencies beyond what they possessed from teaching traditional courses?

Technology-based instruction has been posited to improve instructional behaviors on the part of the teacher. Weiss, Knowlton & Speck (2000) posited that computer-based instructional technologies do not simply provide the same instruction through a different medium, but rather promote a transformation of the teaching and learning process in which faculty revise their pedagogy from a teacher-centered, typically didactic lecture format to one that is more student-centered and based on active learning strategies. Abraham (2002) in a meta-analysis comparing instructional modalities found that technology-based learning environments improved the quantity and quality of the instructors’ learning feedback to the students. A variable not found in this meta-analysis, but suggested as a potential benefit garnered by online instruction was “student motivation”. Abraham (2002) suggested that technology-based instruction might serve to motivate non-traditional learners in a variety of ways and this should be included in future studies comparing pedagogical modalities.

Second, perhaps students who select themselves into web-based courses are more disciplined and effective learners. While this might explain their outperforming in web-based
classes in prior studies, the descriptive data associated with this sample would indicate that this is not a particularly seasoned student population in higher education. The learners in this sample, across instructional modalities, were fairly new to higher education and seemed to favor a higher opinion of more traditional modalities. Overwhelmingly, students who selected the web-based version of the class reportedly did so out of convenience factors, whereas those choosing the other two modalities did so out of meta-cognitive reasons and a low opinion of web-based learning.

Third, we turn to the “levels of processing knowledge” framework to explain the differences in LOI scores between the three groups. Awad & Ghaziri (2004) articulated two types of knowledge: explicit and tacit. Explicit knowledge usually refers to knowledge that can be described, articulated or captured in some systematic manner using languages, models, diagrams or formulas. This type of knowledge is relatively easy to transfer from one person to another without extensive face-to-face interactions and can be codified in documents or systems. Tacit knowledge refers to knowledge that is deep, thick and intertwined; it typically cannot be described systematically using languages, models, diagrams, or formulas. Such knowledge can only be transmitted or acquired through personal experience and therefore is often supported by extensive face-to-face dialog and interactions. The introductory psychology course in question contained mostly explicit knowledge embedded in the learning objectives of the course. Rosenberg (2001) posited that explicit knowledge may be more effectively delivered to and acquired by learners in a technology-enhanced modality. Hui, Hu, Clark, Tam, and Milton (2008) found that no learning settings are universally and equally effective across all subject areas or learning objectives, because some embrace explicit knowledge, whereas others entail tacit knowledge. They found greater learning effectiveness and learning satisfaction when
technology-based learning supports students' accumulation of explicit knowledge rather than tacit knowledge. Learning this type of knowledge involves large amounts of memorizing facts, names, and theories and identifying the application of conceptual information. The deeper more implicit learning involving the use of content and direct application of theoretical concepts is less of an emphasis in an introductory survey course. As a result of the course favoring more surface knowledge, the web-based and web-enhanced format provides students with the creative rehearsal strategies that have been shown to best facilitate the learning of explicit knowledge.

Lastly, the significantly higher scores for the web-based and web-enhance group might be due to the assessment procedure and the congruity of the context of encoding and retrieving information. The “levels of processing” framework might not fully explain the differences in scores on the outcome variable but rather “the principles of encoding specificity” which states that what is learned depends on the learner’s focus of attention and the context of the learning episode. Successful retrieval occurs when the cues at retrieval match what was learned or what cues were available during encoding. Successful retrieval depends on the contextual cues available at retrieval and their similarity to those that existed during encoding. This view of learning has been heavily supported in research studying congruity between the encoding and retrieval contexts (Tulving and Osler, 1968; Tulving and Thomson, 1971; Roediger and Payne, 1983; Emmerson, 1986).

If we start with the assumption that the encoding context for traditional and web-enhanced modalities is the classroom setting, then the retrieval context for the traditional group was congruous with the encoding context, whereas the retrieval context for the web-enhanced group was incongruous with the encoding context. The principles of encoding specificity should predict that the traditional modality should outperform the web-enhanced modality since the
retrieval context in the traditional modality was congruous with the retrieval modality; however, the opposite was found in this study. The web-based condition was the only condition, other than the traditional condition, where the encoding context and retrieval context were congruous in that the encoding took place in the web-based context along with the retrieval.

Instead if we start with the assumption that the encoding process takes place in the context of the web-based assignments in the web-based and web-enhanced modalities, then we may conclude that encoding is not effectively taking place in the traditional modality since it lacks web-based assignments whereby the students independently engage the material within a technological mode within which most of the rest of their interactions reside. The results of this study might be best understood if one assumes that the majority of encoding, and therefore the first step in learning, are best done in the web-based and web-enhanced self-directed, solitary, distributed practice context of outside of the classroom. When the web-based context serves as the context for retrieval, students perform better on learning tasks in that context, because it provides the same cues that were present during the encoding of said material. A future study is needed designed to replicate this study and add a web-enhanced class condition that receives a retrieval task that is incongruous with their web-enhanced encoding context in the form of a live, proctored exams, to then see how scores compare with web-enhanced classes who receive their retrieval task in a congruous context to their encoding context. Similarly a condition by which the traditional class receives their retrieval task in the web-based format should be introduced into the existing paradigm. Further studies should be performed to enhance the findings from this study and examine learning material beyond the introductory level and examine other subjects. These results and explanations beg the question, if learning, as defined by retrieval, is so context specific, “how do students take what they learn in one context and effectively use it in other
contexts to solve problems?” This was the definition of effective learning that this paper started with from Brown, et al. (2014).

Based on the findings the following recommendations may be made:

1. Minimize differences between instructional modalities by adding web-enhancements to provide students with structured ways of independently engaging the material.

2. Provide congruous cues to learning in both the encoding and retrieval contexts.

3. Frequently test recall and recognition in the same context where encoding took place to provide a dipstick for learning.

4. Provide opportunities for the generalization of recall strategies to other contexts, also known as “learning transfer”.

References


