LEARNING OUTCOMES OF WEBINAR VERSUS CLASSROOM INSTRUCTION AMONG BACCALAUREATE NURSING STUDENTS: A RANDOMIZED CONTROLLED TRIAL

A DISSERTATION

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DEDICATION

To my husband, Max,

thank you for your love, ongoing support, and sense of humor that brought perspective when the journey was difficult.

To my savior, Jesus,

who answered prayers and showed me the doorways to walk through to move the research forward.

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ABSTRACT

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LEARNING OUTCOMES OF WEBINAR VERSUS CLASSROOM INSTRUCTION AMONG BACCALAUREATE NURSING STUDENTS: A RANDOMIZED CONTROLLED TRIAL

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There is increased pressure in universities and in the business community to use online methods for adult education. Historically asynchronous technologies have dominated distance education programs. Asynchronous technologies allow the learner any time access to learning activities. Technology has now progressed and synchronous or real-time interactive technologies such as webinars are proliferating. Despite increasing use, research on educational effectiveness is lacking in published research. If evidence is to guide educational practice research of sufficient rigor is required.

A two-group experimental posttest only study was therefore conducted to compare the differential effect of a 30 minute learning module delivered by webinar versus classroom instruction to 224 randomly assigned baccalaureate nursing students. The independent variable was the teaching modality (i.e., webinar versus classroom) and the dependent variable was learning outcomes as measured by the score achieved on an online proctored 30 minute posttest administered immediately after the teaching modality. The posttest was a custom exam developed by Elsevier HESI® Testing, a company experienced in the development of test items based on the NCLEX-RN®

blueprint. The andragogy in practice model and Bloom's revised taxonomy formed the conceptual framework for the study. Webinar participants received the learning module in a classroom via an individual computer and audio/voice headset and classroom participants in a regular classroom without computers. The learning module was taught on the same day by the researcher using the same PowerPoint lecture, with 5 minutes between the groups to minimize opportunities for exchange of information. Study protocols were carefully followed to ensure both groups received equal attention.

The researcher hypothesized that participants randomly assigned to the webinar group would score higher on the posttest than classroom participants. A significant Levene's test of homogeneity prompted the use of the Welch's *t*-test. Based on an alpha of .05 and a one-tailed test, the research hypothesis was not supported. No significance difference in learning outcomes was noted between the groups ($p = .40$). In this study of undergraduate nursing students a webinar was as effective as classroom instruction. Suggestions for further webinar research with other outcomes, in other settings, and with other populations, are explicated.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

There is increased pressure in universities and in the business community to use online methods for adult education. Advantages include reductions in travel time and the associated costs, convenience, and the expanded reach of the educational session made possible by the availability of a computer and a stable internet connection (Colvin Clark & Kwinn, 2007). In a survey for the 2006-2007 academic year, the National Center for Education Statistics (NCES) reported estimated enrollments of 12.2 million in college-level distance education courses (NCES, 2008). In 2-year and 4-year degree granting postsecondary institutions, 66% reported offering online, hybrid/blended online, and other distance education courses for a variety of student audiences. At the college level, 11,200 programs were identified as totally online (NCES, 2008).

Historically, asynchronous technologies have dominated distance education programs. Asynchronous technologies, such video streaming, online interactive web tutorials, and totally web-based courses, allow the learner to access learning activities at will. Interaction between learners and the teacher occurs through email or discussion boards in which messages can be sent and replied to at any time (Asynchronous learning, 2009). Technology has now progressed to include increasing use of synchronous technologies such as webinars. A webinar is an online real-time interactive presentation between a teacher and a variety of learners who are geographically separated. One has only to perform a brief search of the web to note the large number of webinars or online seminars available. Webinar use by universities is also steadily increasing, supported by synchronous platforms such as Adobe Acrobat Connect Professional®, Wimba Classroom®, Elluminate Live®, and WebEx® (Schullo, Hilbelink, Venable, & Barron, 2007). Distance synchronous educational delivery modalities, such as webinars, are increasing in use but what evidence exists to support the efficacy of this educational trend?

Problem of Study

No published empirical research was identified that compared learning outcomes achieved via webinar versus classroom instruction. Experimental research has compared learning outcomes from synchronous online chat to face-to-face chat (Dennis, 2003; Mentzer, Cryan, & Teclehaimanot, 2007). In these studies sample sizes were small ($N = 30$ and $N = 36$ respectively) with no significant difference in learning outcomes reported based on exam scores. Mentzer et al. provided insufficient data for effect size determination. In the study by Dennis (2003) a small positive effect size ($d = .30$) was noted supporting the effectiveness of synchronous chat. Synchronous chat, however, is only one component of webinar learning.

There have been several meta-analyses comparing online distance education (DE) to classroom instruction. The term online distance education, however, is broadly utilized to mean any education in which the learner and instructor are geographically separated and in which an online educational strategy is used. Unfortunately, reported outcomes are not always consistently differentiated into synchronous and asynchronous modalities, so the results have limited utility (Sitzmann, Kraiger, Stewart, & Wisher, 2006; Zhao, Lei, Lai, & Tan, 2005). An additional challenge arises with definitional variations. In the meta-analyses by Bernard et al., (2004) and Lou, Bernard, and Abrami (2006), for example, 'synchronous' was defined as classroom instruction proceeding in synchronization with a distance education classroom located remotely and connected by videoconferencing and/or audio conferencing media. This differs significantly from the webinar synchronous experience.

Perhaps the greatest problem noted in reviewing the meta-analyses and reviews of distance education was the authors' consistent lament about the inability to account for the extreme variability in outcomes due to inadequate descriptions of study design details (i.e., control group condition, randomization procedure, instructor equivalence) (Bernard et al., 2004; Lou et al., 2006; Tallent-Runnells, 2006). A second problem noted in the researcher's review of individual studies was a consistent lack of power due to inadequate sample size that limits discovery of a difference should one exist. In this context one must approach claims of non-significance with skepticism. An experimental study to compare learning outcomes achieved via webinar or classroom instruction with a sufficient sample size was therefore conducted. Baccalaureate nursing students in the first through fourth semester of a nursing program were randomly assigned to attend a learning module via webinar versus classroom instruction. The intent was to extend the limited evidence on distance synchronous education by utilizing a design of sufficient rigor (i.e., adequate sample size and using randomization) to provide beginning evidence to direct educational practice.

Rationale for Study

Utilizing the interactivity of webinars to provide lectures and group discussion as an alternative to classroom is a novel and growing use of synchronous technology for which research is lacking. Research is needed to test the efficacy of new approaches to ensure that meeting pedagogical objectives, and not the technology, drives the educational process. Evidence is needed to ensure that the online classroom can equal or better the learning outcomes achieved in the traditional classroom. The foundation of sound educational practice is research conducted with sufficient rigor to give credence to study findings. This experimental study was one small step toward that aim.

Conceptual Frameworks

The andragogy in practice model, based on the core principles of adult learning formulated by Malcolm Knowles, formed the primary conceptual framework for this study (Knowles, Holton III, & Swanson, 2005). The andragogy in practice model was chosen for this study because it is a "transactional model of adult learning that is designed to transcend specific applications [webinar versus classroom instruction] and situations" (Knowles et al., 2005, p. 143). The core principles define a learner-focused approach to adult education called andragogy which contrasts with pedagogy, the approach typically ascribed to the education of children (Knowles, 1980). According to the model, adults learn best when they know why they need to learn something, when learning is self-directed, when experience is valued and utilized, when learning is needed to cope with real life problems or tasks, when the learning can be applied now, and when the motivation for learning is internal versus external. Application of these principles in this study is described under assumptions. In this updated model two other dimensions surround the central core and must also be considered when developing adult learning experiences, a) the goals and purposes for learning, and b) individual and situational differences. The goal of learning can be individual, institutional, or societal. In this study the goal was to provide a learning opportunity relevant for individual students at all semester levels. Acid-base concepts are introduced in basic pathophysiology and revisited with increasingly levels of complexity as students progress through the nursing program. The topic of acid-base balance was therefore chosen for the learning module.

Situational differences refer to unique factors arising in a particular learning situation that may dictate a different teaching-learning strategy. While the topic of acid-base was relevant, participants in the various semesters came to the learning module with different levels of exposure to acid-base concepts. For students in the last two semesters a case study approach building on experience would have been appropriate, however, such an approach was viewed as too advanced for the first semester students with only the pathophysiology course as background. Knowles, et al. (2005) suggested that in some instances a pedagogical strategy may be appropriate as a starting point but the educator operating under andragogical assumptions "will do everything possible to help the learners take increasing responsibility for their own learning" (p. 70). A decision was made therefore to structure the learning module to move from simple to complex concepts, to reinforce each section with application through brief questions, and to culminate in clinical scenarios that would reinforce the importance in clinical practice and prepare participants to answer such questions on the posttest.

Bloom's revised taxonomy (Black, 2006; Krathwohl, 2002) served as the framework for formulating objectives for the learning module. The original taxonomy was developed in 1956, was unidimensional, and contained six categories in the cognitive domain: knowledge, comprehension, application, analysis, synthesis, and evaluation. These categories were ordered from simple to complex and from concrete to abstract and represented a cumulative hierarchy, that is, mastery of the simpler category was a prerequisite to mastery of the more complex category. As seen in Table 1, the revised taxonomy developed in 2001, is two dimensional (knowledge and cognitive process) with a renaming, redefining, and reordering of the cognitive dimension (Krathwohl, 2002).

Table 1

Bloom's Revised Taxonomy: a Taxonomy Table

The Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Conceptual Procedural Metacognitive						

The revised taxonomy remains hierarchal in the cognitive dimension based on an increasing complexity of the cognitive process from remembering to creating. Objectives are developed using a verb reflecting the cognitive process and a noun or noun phrase representing the knowledge dimension. The intersection of the two dimensions locates the objective in the taxonomy table and allows the instructor to assess visually the extent to which the more complex categories are represented by the objectives. Based on the need to move from simple to complex concepts identified in the situational analysis Bloom's revised taxonomy was seen as congruent with the andragogy in practice model.

Knowles (1980) suggests that while the format of objectives may vary, objectives should be meaningful to the learner and provide directional guidance for learning. The following four learning objectives provided guidance. By the end of the presentation participants would be able to a) identify the key components of acid-base balance, b) distinguish between the four major acid-base disorders, c) apply acid-base balance principles to blood gas analysis, and d) correlate clinical conditions with alterations in acid-base balance, based on clinical scenarios. As seen in Table 2, the four learning module objectives focused on a combination of factual and conceptual aspects of knowledge and the cognitive levels of remembering, understanding, and application.

Table 2

Placement of Study Learning Objectives in the Taxonomy Table

The Knowledge Dimension	The Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual	a)	b)				
Conceptual			c) & d)			
Procedural						
Metacognitive						

Note. The letters in the table refer to the learning objectives.

While the posttest primarily tested application, achievement of the lower level objectives of remembering and understanding was required before application could occur. See Appendix A for the content of the 30 minute learning module linked to the objective, taxonomy, and teaching strategy.

Assumptions

The andragogy in practice model is based on six core assumptions about the characteristics of adult learners. Application of these assumptions in this study was as follows:

1. Adults need to know why they need to learn something before learning it. A description of the learning module and objectives was posted on Blackboard® and email reminders were sent emphasizing the importance of acid-base balance in nursing care. Acid-base balance is part of the required knowledge in each semester.
2. Adults have a deep psychological need to be self-directing, although they may be dependent in particular temporary situations. It was anticipated that participants in the first two semesters (i.e., juniors) would be more dependent learners than participants in the later two semesters (i.e., seniors), based on limited exposure to acid-base concepts. The desire of senior participants to use other approaches to blood gas analysis during the learning module was also anticipated. The need for consistency in content delivery for the research, however, precluded inclusion of

such alternative approaches. In completing the posttest, however, participants were free to determine the analysis approach used.

3. Adults bring experience to the learning situation and attach more meaning to learnings they receive from experience than those they acquire passively. The design of the learning module focused on cognitive learning followed by immediate application based on scenarios designed to simulate the clinical reality. Clinical simulation was particularly important for students with less clinical experience to allow translation into clinical practice.
4. People become ready to learn when a need arises in order to cope with real life problems or tasks. Participants were required to complete online posttests throughout the nursing program. The posttest format offered a learning opportunity for participants to experience in a non-threatening environment, the type of testing required at various points of the nursing program as well as in the National Council Licensure Examination for Registered Nurses (NCLEX-RN®).
5. Learners see education as process of developing competence. Knowles (1980) stated, "They want to apply whatever knowledge and skill they gain today to achieve living more effectively tomorrow" (p. 44). The intent of the learning module was to provide an approach to assessment of a complex state that could be translated immediately into clinical practice.
6. The most potent motivation for adult learners is internal rather than external. Program and eventual success in the NCLEX-RN® examination were likely

shared internal motivations for the participants. Participants were therefore encouraged to view the online test as a non-punitive learning opportunity to improve online test-taking skills for subsequent program exams and for the NCLEX-RN® examination. Adults also respond to external motivators. In this study, a drawing for 10-$20.00 gift certificates was used to encourage participants to spend 30 additional minutes completing the posttest.

Hypothesis

H_A: Baccalaureate student nurses who are randomly assigned to attend a 30 minute learning module entitled "Thinking Critically about Acid-Base Balance" delivered by webinar will score higher on a posttest administered immediately after the module compared to baccalaureate student nurses who are randomly assigned to receive the learning module via classroom instruction.

Support for a directional hypothesis favoring the webinar modality was derived, in part, from a meta-analysis of 51 studies comparing online distance education and face-to-face education (Zhao et al., 2005). Zhao et al. (2005) reported that distance learning has a significantly better effect than face-to-face education when instructor involvement is medium or high, when education is at the undergraduate level, and when the content focuses on medical topics. In the meta-analysis by Sitzmann et al., (2006) and by Lou et al. (2006), interactivity was also supportive for the effectiveness of distance education.

Definition of Terms

Webinar

Conceptual: The Merriam-Webster Online Dictionary (2010) defines a webinar as a "live online educational presentation in which participating viewers can submit questions and comments" ("Webinar"). A webinar uses synchronous technology. Interaction between the presenter and the audience occurs *live* via voice and/or through the use of real-time chat. Participants join the education session as an individual or in a group via an internet-capable computer using an application provided by a web conferencing company. Voice capability occurs by telephone or via the computer using a voice over internet protocol (Millard, 2007). Depending on the application or platform, the presenter may use a PowerPoint presentation, a whiteboard, conduct polls or surveys, do break out discussion groups, respond to real-time text-based chat, or share a desktop (Panton, 2005).

Operational: Webinar participants received an online live PowerPoint presentation in a computer classroom at the university via an individual computer and headset, hosted on the WebEx® conferencing platform, and using a voice over internet protocol and real-time text-based chat.

Classroom Instruction

Conceptual: A classroom is defined as a place for conducting formal instruction of students by a teacher in a school or college ("Classroom", 1993).

Operational: Classroom participants received a live PowerPoint presentation in a regular classroom without computers.

Posttest

Conceptual: A posttest is defined as “a test given to students after completion of an instructional program to measure their achievement and the effectiveness of the program” (“Posttest”, 1993).

Operational: The posttest was a proctored 30 minute online 25 item multiple choice test, developed by Elsevier HESI® Testing, completed immediately after the learning module. The online format allowed forward movement only.

Learning module

Conceptual: A module is an educational unit that covers a single topic or subject (“Module”, 2010).

Operational: The learning module was a 30 minute PowerPoint presentation on “Thinking Critically about Acid-Base Balance”, with 25 minutes of didactic and 5 minutes of application based on clinical scenarios.

Learning Outcome

Conceptual: Knowles et al. (2005) defined learning is “the process of gaining knowledge and/or expertise” (p. 17). Outcome is defined as “something that comes out of or follows from an activity or process” (“Outcome”, 1996). A learning outcome therefore is a gain in knowledge and/or expertise after a learning activity. Research focused on measuring learning outcomes has used a variety of indicators ranging from student satisfaction with learning to tests of knowledge to skill demonstrations (Sitzmann et al., 2006; Zhao, et al., 2005).

Operational: Learning outcomes were defined as the attainment of knowledge as measured by the score on the online proctored 30 minute posttest administered immediately after completion of the learning module.

Limitations

One of the criticisms of the experimental method is artificiality. There is a need to focus only on a handful of variables while attempting to hold all else constant (Polit & Beck, 2008). In this study, concern over internal validity and the need to have a proctored exam process prompted the decision to have webinar participants receive the learning module in a computer classroom at the university using an individual computer and headset rather than allowing participants to choose the delivery location, as would normally occur in a webinar. This limits generalizability of the study's results to the particular study context. The study population of undergraduate nursing students is another limitation. One cannot take these results, for example, and apply to webinar learning by staff nurses or graduate nurses. Given that the posttest was administered immediately after the learning module one may argue that the results represent recall rather than learning. This remains a possibility, even though the posttest was designed to test at the application level. A final limitation, with unknown consequences, was the possible impact on learning outcomes of an exam whose score does not affect the student's final grade.

Summary

This experimental posttest only study measured learning outcomes in baccalaureate nursing students who were randomly assigned to attend a 30 minute learning module delivered by webinar versus classroom instruction. The andragogy in practice model (Knowles et al., 2005) and Bloom's revised taxonomy formed the conceptual framework to guide the design and implementation of the learning module. An online posttest developed by Elsevier HESI® Testing was used to measure learning outcomes. Though synchronous technologies such as webinars are increasingly being used as an alternate to the traditional classroom evidence of webinar effectiveness compared to classroom instruction is lacking. Though generalizability is limited, this study provides beginning evidence to guide educational practice.

CHAPTER II

REVIEW OF LITERATURE

Advances in computer technology and the demands for the convenience of online learning are changing the face of adult education. In the past, asynchronous technologies have dominated the distance education landscape. Technology has now progressed to include increasing use of synchronous technologies such as webinars in both university and business settings (Wexler et al., 2007). Synchronous technologies, in contrast to asynchronous, allow real-time communication and provide the opportunity to create a virtual or online classroom that has the potential of rivaling the traditional classroom. In universities synchronous platforms such as Adobe Acrobat Connect Professional®, Wimba Classroom®, Elluminate Live®, and WebEx® are being used to replace the traditional classroom lecture with online live lectures (Schullo et al., 2007). Online strategies are proliferating but what evidence exists to support the effectiveness of this educational trend?

This chapter is an integrated review of online distance education research aimed at identifying evidence of the effectiveness of online versus traditional classroom instruction, with an emphasis on synchronous technologies. In this review gaps are identified that lend support for the current study comparing learning outcomes in randomized baccalaureate nursing students achieved via webinar versus classroom instruction. Discussion of the review's scope and clarification of technological terminology will preface discussion of the current state of research comparing online and classroom instruction.

Scope of the Review

Four meta-analyses of research on online distance education were reviewed and together cover the time period from 1966-2007 (Bernard et. al., 2004;Lou, et al., 2006; Sitzmann, et al., 2006; Zhao, et al., 2005). Three of the four meta-analysis articles did not extend beyond 2002 (Bernard et al., 2004; Lou et al., 2006; Zhao et al., 2005). A search for current research therefore spanned from 2003 - present. To be included in the review the research had to focus on comparing synchronous online and traditional classroom instruction, occur in a university setting with students as the population, and provide information on learning outcomes. Priority was given to research focused on nursing students but studies with other student groups were not excluded, particularly if these studies used an experimental design. Databases searched included Pub Med®, CINAHL®, Academic Search Complete®, Science Direct®, Professional Development Collection®, and Education Research Complete®. In addition an ancestry approach or "footnote chasing" was used to elicit additional references (Polit & Beck, 2008, p. 109). Research articles located in a prior search of ERIC® were also included. Choice of databases was predicated on finding a balance between an education and a nursing focus. Search terms identified from database thesauruses and descriptors and relevant articles were applied in various combinations to the title, abstract, and key word. The same search strategy was applied in each database. Search terms included face to face OR classroom, web-based OR web-enhanced, distance education OR distance learning, internet-based OR elearning OR online, web-conferencing OR e-conferencing OR synchronous, video-conferencing OR videoconference, and virtual classroom OR webinar OR webcasting. The lack of a consistent nomenclature coupled with ongoing technological evolution made searching and capturing relevant research a challenge.

Terminology Clarification

Distance education is broadly defined as education in which the instructor and the student are geographically separated (Tallent-Runnels et al., 2006) and includes paper-based or compact disc (CD ROM) based correspondence courses. To be included in the current research review, the research had to focus on distance education that compared a course delivered completely online to that delivered by classroom. Hybrid, web-enhanced, or blended courses that combine online technologies with the traditional face-to-face components (Tallent-Runnels et al., 2006) were therefore excluded.

Two technologies are being used to deliver online instruction, asynchronous and synchronous. Synchronous learning is live or real-time online instruction that requires the presence of both the teacher and the learner at the same time for learning to take place (Chen, Ko, Kinshuk, & Lin, 2005). Examples of synchronous learning include webinar or web conferences ("Webinar", 2010), videoconferencing, or live computer chat sessions. In asynchronous learning there is no live interaction and the time of the interaction is determined by the participant ("Asynchronous learning", 2009). This is the type of interaction common in university online systems with anytime chat, in email systems, in newsgroups, in web blogs, and archived lecture presentations.

Online versus Classroom Instruction: A Meta-Analysis Perspective

Four meta-analyses were identified that focused on comparing online distance education with traditional classroom instruction. A very large meta-analysis by Bernard et al. (2004) is excluded from the detailed discussion that follows as learners from all levels of education ranging from kindergarten to adults in both school and corporate training settings were included and the published results did not distinguish education level. Of note, however, was a general problem identified by these and other authors (Lou, et al., 2006; Tallent-Runnels et al., 2006) of inadequate reporting in published research of study design details (i.e., the control group condition, the randomization procedure, instructor equivalence). As will be seen, in the discussion to follow, in some instances online distance education has better learning outcomes and in other cases the reverse was true. Inadequate reporting of design details limits a full understanding of these variations.

The meta-analysis by Lou et al. (2006) used a subset of the review by Bernard et al. (2004) and focused on assessing the effects of distance education versus classroom instruction on undergraduate student achievement. In all, 218 independent findings from 103 studies representing 25,320 students were analyzed in this meta-analysis. Of those findings, 58 were identified as synchronous and 122 as asynchronous. To be included in the meta-analysis the study had to use comparable measurable outcomes focused on individual courses, rather than whole programs. Both experimental and non-experimental research was included with study quality differences controlled with weighted multiple regression techniques. As described previously, use of the terms synchronous and asynchronous differs from that currently seen in the literature. In this meta-analysis synchronous distance education was defined as classroom instruction proceeding in synchronization with a distance education classroom located remotely and connected by videoconferencing and/or audio conferencing media. On the other hand, asynchronous distance education conditions were conducted independently of the classroom comparison and did not exclude the possibility of synchronous communication between students and/or between students and instructors. Based on this definition, if a comparison of webinar versus classroom had arisen in this review it would have been classified as asynchronous.

Measurement of effect size was described using Hedge's g. Use of Hedge's g for effect size calculations removes sampling bias when sample sizes are small, producing a slightly smaller effect size than the same estimate achieved using Cohen's *d*. The difference between *d* and *g* tends to be less as *N* gets larger, with similar results achieved with large samples (Lou et al., 2006). When multiple achievement data were reported, such as assignments and midterm examinations, final examination scores were used in calculating effect sizes. During analysis statistical procedures by Hedges and Olkin were employed to weight the effect sizes, such that more weight was given to findings based on larger sample sizes. As described by Lou et al. (2006), "The weighted effect sizes were then aggregated to form an overall weighted mean estimate of the treatment effect (g+)" (p. 152). In this study, a significantly positive mean effect size supported distant education effectiveness and a significantly negative mean effect size supported the effectiveness of traditional classroom-based instruction.

Among undergraduate students the weighted mean effect size for the 58 synchronous distance education findings was g+ = - 0.023, representing a negligible effect, and the results were homogeneous. In all the studies combined, students who attended a class offered remotely via video-conferencing had examination results comparable to students in the classroom at the host site. The weighted mean effect size for the 122 asynchronous distance education findings was g+ = +0.058, indicating a small but significantly positive effect supporting the effectiveness of distance education over classroom instruction. This effect was even larger when findings that employed media to support student discussion were analyzed (g+ = +0.109). Heterogeneity was evident, however, in these asynchronous comparisons prompting further analysis. Regression analysis identified several predictors of more positive asynchronous distance education student achievement compared to classroom instruction. These predictors included the use of computer based instruction such as tutorials and simulations and the use of broadcast TV or videotape (2.7 % of the variance), media such as asynchronous chat used to support collaborative discussion among students and the opportunity for face-to-face interaction with other students (7.16% of variance), and student-instructor interaction which included face-to-face meetings with the instructor (9.28% of variance). When combined, between-students and student- instructor interaction accounted for 16.44% of the variance. Again this definition of asynchronous differs from common usage in the literature.

Zhao et al. (2005) also conducted a meta-analysis of 51 studies between 1996-2002 with an aim to discovering the reasons for the variation in comparisons of distance education and classroom identified in previous meta-analyses. These authors argued that rather than dismissing previous research as of low quality and having little to offer in terms of practical guidance a closer examination of the variability was warranted. In this meta-analysis 98 effect sizes were derived from the 51 studies, with 11,477 participants. Experimental and quasi-experimental designs were included in the meta-analysis, with the differentiating characteristic being the use of random sampling. Cohen's *d* was used to calculate the effect size with a weighted correction to correct for the bias introduced by small sample sizes. More weight was therefore given to findings from large samples. Positive effect sizes represented a better outcome for distance education than classroom instruction. Analysis was conducted using both a fixed-effect and random effect regression model, with similar results. Results based on the fixed effect model are discussed here. In a fixed effect model, studies are assumed to be measuring the same overall effect, so a pooled effect estimate is calculated under the assumption that the observed variation between studies is attributable to chance (Polit & Beck, 2008). A framework to guide analysis was developed by coding of studies using a grounded theory approach. The final variables included in the reported meta-analysis focused on effectiveness and included publication features (year and instructor as author) and instructional features (teacher, student, curriculum, milieu). The milieu included instructional level (i.e., undergraduate, graduate), interaction type (asynchronous, synchronous, noninteractive, both synchronous and asynchronous) and media involvement (level of technology, coded from 1 or low to 10 or high).

A limitation of this meta-analysis is that the specific outcome measure used to determine the effect size for each variable was not limited to learning outcomes. Outcome measurements included: grades, quizzes, independent/standardized tests, student satisfaction, instructor satisfaction, dropout rate, student evaluation of learning, student evaluation of course, and external evaluation. Zhao et al. (2005) suggested that what is used as an outcome measure can have a significant effect on the difference between distance education and face-to-face education. "When grades (including quizzes), student attitude and beliefs, student satisfaction, and student participation are measured or when the outcome is based on the researcher's observation, distance education shows a significantly better outcome than face-to-face learning" (p. 1856). In 36 research findings in which grades were used as the outcome measure a small effect supporting distance education was reported, $d = 0.14 \pm 0.07$, $p < .001$. In contrast, when student evaluation of learning was the outcome face-to-face education was slightly better than distance education but the result was not significant ($d = -0.08 \pm 0.55$).

Similar to that noted in the meta-analysis by Lou et al. (2006), instructor involvement was identified as a significant moderator of distance education effectiveness.

Distance education was more effective than face-to-face or classroom instruction when instructor involvement was at the medium (d = $0.29 \pm 0.08, p < .001$) or high level (d = $0.21 \pm 0.06, p$ =< .001) and less effective when instructor involvement was at a low level (d = $-0.24 \pm 0.14, p < .001$). In a comparison of 16 synchronous, five asynchronous, and 58 mixed interaction (using both synchronous and asynchronous) findings, mixed interactions were identified as significantly better than face-to-face ($d = 0.22, p < .001$). Though no significant difference was noted in synchronous findings ($d = 0.08 \pm 0.10$), 12 of the 16 synchronous findings occurred prior to the year 2000 and as such may not be comparable to the synchronous technologies available today. In terms of content and instructional level, better outcomes were achieved in distance education programs compared to classroom in business ($d = 0.13 \pm .08, p < .001$), computer science ($d = 0.48 \pm .11, p < .001$) and medical science ($d = 0.36 \pm .13$, $p < .001$) and in programs offered at the undergraduate level ($d = 0.36, p < .001$).

Sitzmann et al. (2006) conducted a meta-analysis of 96 research reports from 1996-2005, focused on instructional content. The analysis was based on 71 effect sizes and 10,910 learners. The authors hypothesized that web-based instruction (WBI) would be more effective than classroom for teaching declarative and procedural knowledge. Declarative knowledge, which refers to the student's memory of facts, principles, and concepts taught in the educational program, was assessed based on a written test. Procedural knowledge, or the ability to perform the skills taught, was assessed via demonstration or a written test of cognitive recall of the required steps for skill completion. Web-based instruction was defined as a course where the material is delivered over the internet and classroom as a course where the material is delivered face-to-face with an instructor. The topic of the training courses varied greatly and included psychology, engineering, computer programming, business, and technical writing courses. Overall the results indicated that web-based instruction was 6% more effective for teaching declarative knowledge ($d = 0.15$), and that the two delivery methods were equally effective for procedural knowledge ($d = -0.07$). These authors also noted that differences for declarative knowledge disappeared when the same instructional method was used for web-based instruction and classroom, suggesting that it is the instructional technique and not the media that accounts for the difference ($d = 0.04$). Attention to course design was identified as critical to maximizing learning outcomes. In situations in which the learner was given control, practiced the material, received feedback during training and participated in a long course, web-based instruction was 19% more effective than classroom for declarative knowledge ($d = 0.49$). When these features were missing, the classroom was 20% more effective ($d = -0.51$). More than media must be considered to achieve learning outcomes.

There is a danger when findings are grouped for comparison that important differences in individual studies may be lost. In the meta-analysis by Zhao et al. (2005), for example, the authors reported that when the studies were considered as a whole the overall weighted mean effect size between distance education and face-to-face education was $d = 0.10, p = .06$ confirming the no significant difference claim of other researchers in prior literature reviews. It was only when the results were broken down into smaller categories that subtle differences surfaced (i.e., instructor involvement at the medium level supports distance education, $d = 0.29 \pm 0.08$, $p < .001$). If research is to guide educational practice the results of individual studies must also be considered. Effect size must also be considered. Statistical significance does not necessarily equate to significance for educational practice. In the three meta-analyses reviewed, most of reported effect sizes supporting the effectiveness of distance education over classroom instruction were less than 0.36 with the majority close to or equal to 0.20. These effect sizes represent a small (0.20) to medium effect (0.50) (Polit and Beck, 2008). The question to be answered is, at what point is the effect size large enough to warrant consideration of a change in educational practice?

Online versus Classroom Instruction: An Individual Study Perspective

Six studies comparing learning outcomes in synchronous distance education versus classroom instruction were identified. Synchronous chat was the most commonly used technology comprising 5 of the 6 studies (Buckley, 2003; Dennis, 2003; Hansen, 2008; Mentzer et al., 2007; Newlin, Lavooy, & Wang, 2005). Synchronous chat is real-time text-based chat (“Online chat”, 2009). The remaining study compared onsite classroom lectures to lectures received by synchronous televideo conferencing (TVC) (Kerns, McDonough, Groom, Kalynch, & Hogan, 2006). This is the type of synchronous technology discussed in the meta-analysis by Lou et al. (2006). No published studies were found that compared webinars or web conferencing to the classroom, though discussion is appearing in the descriptive literature about the effectiveness of this approach (Colvin Clark, & Kwin, 2007; DiMaria-Ghalili, Ostrow, & Rodney, 2005; Shield et al., 2005).

Research Supporting No Significant Difference

In a descriptive comparative posttest only design, Buckley (2003) compared midterm, final examinations, and course grades in a convenience sample ($N = 58$) of undergraduate nursing students who attended a nutrition and health course transitioned from a traditional classroom, to a web-enhanced, to a web-based course, over 3 semesters. The web-based course was totally online and consisted of 15 self-study modules with five synchronous chat discussions to facilitate instructor-student interaction. No significant difference was found between the three groups on the midterm (F [2, 57] = 2.94, p = .06), final examination (F [2, 57] = 0.46, p = .62) or course grades (F [2, 57] = 1.37, p = .3). Kerns et al. (2006) used a quasi-experimental, non-equivalent group, posttest only design, to compare academic performance of graduate anesthesiology nursing students who viewed lectures in person compared to students who received the lecture by live televideo conferencing. Learning outcomes were measured by the Self-Evaluation Examination (SEE) administered at the end of the program's first year. This is an examination from the Council on Certification of Nurse Anesthetists that is generally completed during the first or second year of study. Ten students comprised the televideo group and 26 students the classroom group. Based on an independent *t*-test, no significant difference in examination scores was noted ($p = .52$).

Two experimental posttest only studies were identified. Dennis (2003) compared the use of synchronous chat versus a face-to-face tutorial for problem-based learning on learning outcomes, time on task, and learning issue generation, in 34 physiotherapy students. In the synchronous chat the discussion appeared as text that could be saved and emailed to the student for future reference. Each group was further divided into three subgroups with 5 - 6 students based on the recommended group size for problem-based learning and were facilitated by one of three faculty. In terms of the overall grade achieved, an independent *t*-test did not demonstrate any significant difference between the groups ($p > .05$).

Mentzer et al. (2007) compared learning outcomes in 36 undergraduate early childhood program students who were randomly assigned to a face-to-face or to a web-based course with synchronous chat. No significant difference was noted between the groups in terms of midterm and final examination scores. The comparison of overall grade did differ significantly ($p = .02$), with students in the face-to-face achieving an A- and the experimental group achieving a B. This was attributed, however, to incomplete assignment submissions by the web-based group rather than lower grade achievement.

Research with Mixed Results

Two synchronous studies reported mixed results. In a quasi-experimental, non-equivalent group, posttest only design, objective knowledge and knowledge transfer was compared among online and classroom students in a Principles of Marketing course (Hansen, 2008). The content for both groups was the same. The online course used

Blackboard® with twice weekly synchronous chat augmented by PowerPoint outlines and internet topics. The classroom group received live lecture with PowerPoint and internet topics. The study was replicated in three semesters ($N = 48$, $N = 48$, $N = 47$). The groups were not equal, with online students as $N = 15$, $N = 26$, $N = 19$, respectively. Hansen (2008) reported non-significance for objective knowledge, as measured by mid-course multiple choice tests and a final exam, but noted differences in knowledge transfer between the online and classroom students in a small group project. Those in the online course had significantly higher scores for presentation ($p < .001$) and for planning ($p < .001$) in the group project and effect sizes were moderate to large (0.46 - 0.99). Hansen (2008) attributed this difference to a greater sense of community reported by online students (as measured by a subjective rating of community on an 11 point scale) "which led to more independence and greater cooperation among team members in the online classes" (p. 101).

In the experimental study by Newlin et al. (2005), 91 students in an upper level psychology course were randomly assigned to one of three conditions: conventional teaching ($N = 31$), web-synchronous ($N = 30$), and web asynchronous ($N = 30$) instructional formats. A 20 minute lecture was presented live to the classroom group, pasted into a chat window live for the synchronous group, and provided for online review for 20 minutes for the asynchronous group. Although the researchers reported no significant difference in knowledge, $F(2, 89) = 0.44$, $p = .65$, the online students reported that they felt they had learned the material better than those in the classroom group, t (86) = 2.01, $p < .05$.

Problems in Individual Studies

The methodological problems with inadequate description of study design details reported in the meta-analyses (Bernard et al., 2004; Lou et al., 2006) persisted in the search for current studies. Failure to adequately describe the control or classroom situation, as identified by Bernard et al. (2004) as well as the experimental condition was noted. Translation of research into practice requires a clear understanding of what the research involved. Several studies had to be excluded from this review based on inadequate reporting of the above research design details. In studies reporting significant results statistical evidence was sometimes lacking (no p values, no means) and effect sizes were rarely included. Effect size is important in order to understand the magnitude of the difference noted and must be considered when using research to drive changes in educational practice.

An additional problem concerns the small sample size in the majority of these studies. Small sample sizes create problems with the power of the research to accurately identify differences that are actually present (Lipsey, 1990). This leads to a Type II error. In the study by Newlin et al. (2005), for example, the power of this study to determine an effect assuming a moderate effect ($d = 0.50$) and a group sample size of 30 is slightly less than 50% (Lipsey, 1990). Given a small effect size of 0.20 (which appears to be more common in the literature) the power of this study to detect a difference, should one exist, falls dramatically to slightly greater than 10%. Reports of no significance must therefore be interpreted with caution when sample sizes are small.

Summary

This review included a overview of three meta-analyses as well as a review of individual synchronous research, from 2003 to present, on the effectiveness of online distance education compared to the traditional classroom. Lack of rigorous reporting of research design details confounds interpretation of the meta-analyses and in the search for individual studies prompted study exclusion. The meta-analysis by Lou et. al. (2006), focused on undergraduate students, using a subset of studies reviewed by Bernard et al. (2004). Zhao et al. (2005) conducted a meta-analysis based on a framework of variables impacting education derived from a grounded theory approach. Sitzmann et al. (2006) focused on comparing declarative and procedural knowledge outcomes in web-based instruction versus classroom instruction. Variable results were reported in the meta-analyses: in some instances students in online distance education outperformed the classroom students; in other instances, the reverse was true; and in still other instances there was no difference in performance. One trend did surface. Interaction of students with the instructor, with other students, and with the content resulted in better performance by students in online distance education (Lou et al., 2006; Sitzmann et al., 2006, & Zhao et al. 2005).

A major problem in the individual review of research were the power issues related to small sample sizes prompting caution in interpretation of results of no significance, and the methodological concerns that limited study inclusion. Additionally no published research was noted that focused on comparing learning outcomes achieved in a webinar versus classroom instruction. A brief search of the internet provides evidence of numerous opportunities for education via webinars. In The New Virtual Classroom, authors Colvin Clark & Kwinn (2007) included numerous testimonials by several companies involved in using webinar technology. The Distinguished Lecture series on the Wimba® website includes presenters from schools and universities across the United States, currently using the platform (Wimba, 2009). The technology is being used but there is a lack of published research supporting the effectiveness of this new technology.

The rigor of experimental research is needed in order to untangle the web of variables that are impacting the results of online versus classroom comparison. As Lou et al. (2006) suggested, this includes control of the methodological factors such as instructor equivalence, instructional material equivalence, and time on task differences, as well as detailed reporting of instructional conditions and methodological features in subsequent publication, so a more complete picture of distance education effectiveness can be developed.

CHAPTER III

PROCEDURE FOR COLLECTION AND TREATMENT OF DATA

A two-group experimental posttest only design was used to study the differential impact on learning outcomes of a 30 minute learning module delivered via webinar versus classroom instruction to randomly assigned baccalaureate nursing students. Participants were undergraduate nursing students who agreed to complete a 30 minute online proctored posttest, developed by Elsevier HESI® Testing, immediately after the learning module. Webinar participants received the learning module in a computer classroom with an individual computer and headset. Classroom participants received the learning module live in a regular classroom. The content was delivered by the researcher, using the same PowerPoint presentation for both the webinar and classroom instruction. The independent variable was the teaching modality (webinar versus classroom instruction). The dependent variable was learning outcomes as measured by the score achieved on the posttest administered immediately after the learning module. Study protocols were closely followed to ensure that both groups received equal attention (see Appendix B).

Setting

Baccalaureate nursing students at a large university in the southern United States were randomly assigned to attend the learning module by webinar versus classroom instruction. Undergraduate students at this university are in the last two years of the baccalaureate nursing program. While the university also has a Registered Nurse-Bachelor of Science program, students in this program were not included in the study.

Population and Sample

Junior and senior undergraduate nursing students in the spring 2010 semester comprised the population. With the permission of course faculty, students were randomly assigned to receive the learning module by webinar or classroom instruction and were awarded course credit per instructor decision. The date, location of the course, and group assignment was included in the Course Information on Blackboard®.

No published empirical research comparing posttest scores achieved with webinar versus classroom instruction was identified to serve as a basis for determining sample size. The search therefore broadened to include research on learning outcomes that compared synchronous chat to classroom discussion. Synchronous chat is part of the webinar experience. Three studies testing synchronous chat were used to determine effect size (Dennis, 2003; Hansen 2008; Newlin, et al., 2005). Effect sizes were generally small and ranged from 0.13 (Hansen 2008; Newlin, et al., 2005) to 0.30 (Dennis, 2003). Sample sizes were also small with 15 - 33 in each group in Hansen's (2008) study, repeated over 3 semesters. In the other two studies, $N = 17$ and $N = 30$ respectively (Dennis, 2003; Newlin et al., 2005).

Given that the webinar is a synchronous event that includes more than synchronous chat more interaction and a higher effect size was expected. In this study, however, the interaction occurred once and not over time. Therefore a small effect size of

0.30 was chosen. Based on an effect size of 0.30, an alpha of .05, and a one-tailed test, 140 participants per treatment group or a total sample of 280 participants was required to achieved a power of 0.80 (Lipsey, 1990). Estimated sample size was 301 if all students agreed to participate that were eligible at the study site.

Protection of Human Subjects

Prior to conducting the study, approval was received from the Institutional Review Board of Texas Woman's University in Houston. Students were advised that there was a research component at the end of the learning module consisting of a 30 minute online posttest, and that the responses would be used only for the research. Testing requirements, risks, and benefits, were reviewed at the end of the learning module and prior to completing the posttest. Participants were taken to a separate room for the online posttest. On entry to the testing room participants were given a group code (webinar or classroom) and an identification number to use at login instead of their name. A user acknowledgement screen then appeared which reinforced the intended use of the data for research purposes only. Selecting "agree" constituted informed consent. Anonymity in relation to the posttest scores was therefore assured. Any potential loss of confidentiality was mitigated by the reporting of study results as aggregate findings only. Individual students or the participating university will not be identified in any published reports.

Potential benefits to the participants included the opportunity to experience, without penalty for poor performance, a testing format and test items similar to that experienced in a National Council Licensure Examination (NCLEX-RN®). Additional benefits included a certificate of completion with a notation of research participation for inclusion in the student portfolio, the opportunity to further student learning in the principles of acid-base balance analysis and application in patient care, and the opportunity to enter their name in a drawing for one of 10, $20.00 gift certificates for a local store.

Instrument

A valid and reliable instrument to measure learning outcomes was central to the success of the study. A decision was therefore made to seek the assistance of Elsevier HESI® Testing, a company experienced in the development of test items based on the National Council for Licensure Examination (NCLEX-RN®) blueprint. Classical test theory is the foundation of Elsevier HESI® item design and the validity and reliability of Elsevier HESI® specialty exams and exit exams is well established (Morrison, Adamsons, Nibert, & Hsia, 2006). For this study, Elsevier HESI® Testing developed an online exam, derived from items in the Elsevier HESI® Testing database that fit with the selected content and objectives of "Thinking critically about Acid-Base balance". Though the exam developed for this research was not tested in its entirety as a whole exam, each exam item had been previously tested on baccalaureate nursing students. As stated by Morrison et al. (2006), the parameters used by HESI® to judge item quality include a cumulative difficulty level of "no less than 40% and a point biserial correlation of 0.15 and above" (p. 42S). This remains the standard for current test development (Dr. P.

Willson, personal communication, February 22, 2010). Upon completion of the learning module, participants in both groups completed a 30 minute proctored online Elsevier HESI® Testing custom multiple choice posttest. A 30 minute posttest was required as the test items were written at the application level and required approximately 1.36 minutes per question in keeping with the testing standard of the National Council of State Boards of Nursing. It was estimated that four testing sessions would be required, with classroom and webinar sessions occurring on the same day for students in each semester level. The reported reliability was an accumulation of all testing sessions. Due to the proprietary nature of the posttest the instrument is not included. See Appendix C for a sample of the type of questions participants may have encountered.

Data Collection

Participants in both groups received the learning module in a classroom. Webinar participants received the module in a classroom via individual computers and audio/voice headsets and the classroom participants in a regular classroom without computers. Students were advised that there was a research component at the end of the learning module, consisting of a 30 minute online proctored posttest, and that the responses would be used only for the research.

At the end of the learning module, risks and benefits and testing requirements were reviewed. Willing participants then proceeded to a room prepared for administration of the proctored online posttest. On entry to the exam room, participants were given a group code (webinar or classroom) and an identification number to use at login instead of their name. A user acknowledgement screen then appeared which reinforced the intended use of the data for research purposes only. Selecting "agree" constituted informed consent. In this study, the normal values for blood gas analysis (PaO_2, pH, CO_2, HCO_3) were projected on a screen in the exam room. In addition students were given a blank piece of paper to use as they deemed fit during the exam. This paper was collected at the end of the examination.

Students participating in the research received a certificate of completion detailing their research participation and had the opportunity to place their name into a drawing at the end of the research, for one of ten $20.00 gift certificates from a local store. Students not participating received a certificate of completion for the learning module. All students who completed the learning module received course credit as determined by the course faculty.

Treatment of Data

Once all the scheduled learning modules and associated online posttests were completed the testing session was closed and all online test results were automatically transmitted by a secure server to the Elsevier HESI® Testing for compilation into an SPSS spreadsheet. Elsevier HESI® Testing then returned the data to the researcher via a secure location at the university. Use of the group code and identification number instead of participant names meant that the researcher did not know which participant made the response. The SPSS spreadsheet was kept in a password protected computer accessible only to the researcher. Reliability statistics for the instrument were computed on aggregate data by Elsevier HESI® Testing and by the researcher on the study data and included point biserial correlations, item difficulty, and a Kuder Richardson Formula 20 (K-R 20) and Cronbach's alpha.

An independent *t*-test was conducted using the Statistical Package for Social Sciences (SPSS) software program, version 17.0, to look for differences between the two groups. Frequencies and histograms were run to screen for data entry errors, to assess outliers, and to assess normalcy. Levene's test for homogeneity of variance was conducted. The level of significance was set to an alpha of .05 for one-tailed directional hypothesis testing.

Upon completion of the final analysis and in keeping with the research agreement with Elsevier HESI® Testing, all electronic spreadsheets or other types of files generated from the statistical software packages were returned to the company by a secure server and electronic files on the researcher's computer were destroyed after confirmation that the received files were uncorrupted, complete, and accessible on the Elsevier HESI® computer system.

Summary

A two-group experimental posttest only design was used to assess the differential impact on learning outcomes of a 30 minute learning module delivered via webinar versus classroom instruction to randomly assigned baccalaureate nursing students. Completion of the login to the testing site for the posttest constituted informed consent. Posttest responses were only used for the research. Risks to participants were minimal as no names were associated with posttest completion. Additionally, subsequent publication of the study's findings will report aggregate data only. Individual students or the participating university will not be identified in any publications. Participant benefits included the opportunity to further learning related to acid-base balance, to receive a certificate acknowledging research participation for the student portfolio, to experience online testing without penalty for poor performance, and to participate in a drawing for one of 10 \$20.00 gift certificates for a local store. Analysis of data was completed using an independent *t*-test statistic at an alpha level of .05 for one-tailed directional hypothesis testing.

CHAPTER IV

ANALYSIS OF THE DATA

A two-group experimental posttest only design was used to assess the differential impact of a 30 minute learning module delivered via webinar versus classroom instruction to randomly assigned baccalaureate nursing student participants. The independent variable was the teaching modality (i.e., webinar versus classroom instruction) and the dependent variable was learning outcomes as measured by the score achieved on an online proctored 30 minute posttest administered immediately after the teaching modality.

After IRB and Agency approval was obtained (see Appendix D and E), junior and senior baccalaureate nursing students were randomly assigned to receive the same learning module presented by webinar or by classroom instruction. The webinar and classroom sessions were offered on the same day, 5 minutes apart, to minimize opportunities for group exchange of information. Webinar participants received the module in a classroom with individual computers and audio/voice headsets and classroom participants in a regular classroom without computers. Both groups were taught by the researcher using the same PowerPoint lecture. Study protocols were closely followed to ensure that both groups received equal attention (see Appendix B).

Upon completion of the learning module willing participants proceeded to the exam room for administration of the proctored timed online posttest. Participants were given an identification number and group name (web or class) to use at login instead of their name. A user acknowledgement screen prefaced testing, which reinforced the intended use of the data for research purposes only. Selecting "agree" constituted informed consent. A description of the study sample and a presentation of research findings are presented in this chapter.

Description of the Sample

Nursing students in the last two years of a baccalaureate nursing program at a large university in the southern United States comprised the study population. With the agreement of course faculty, junior and senior students were randomly assigned to attend the learning module by webinar or classroom instruction. The learning module was an optional part of a course, with additional credit for participation per instructor decision. As seen in Figure 1, 303 students were randomly assigned based on student rosters with 151 students allocated to the webinar group, and 152 students to the classroom group. After allocation, a notice was placed in the course information on Blackboard® describing the learning module content and objectives, the group assignment, and course credit (see Appendix F). Email and Blackboard® announcement reminders were sent after the original posting at 2 weeks, 1 week, and the day prior to the learning module to both faculty and students. Webinar participants were 123, with 28 non-participants; classroom participants were 122, with 30 non-participants. Reasons for not attending the module varied and are presented in Figure 1. A total of 245 students attended the learning module and of these 224 completed the posttest. Attrition was 8.6%. The final sample consisted of 113 in the webinar group and 111 in the classroom group.

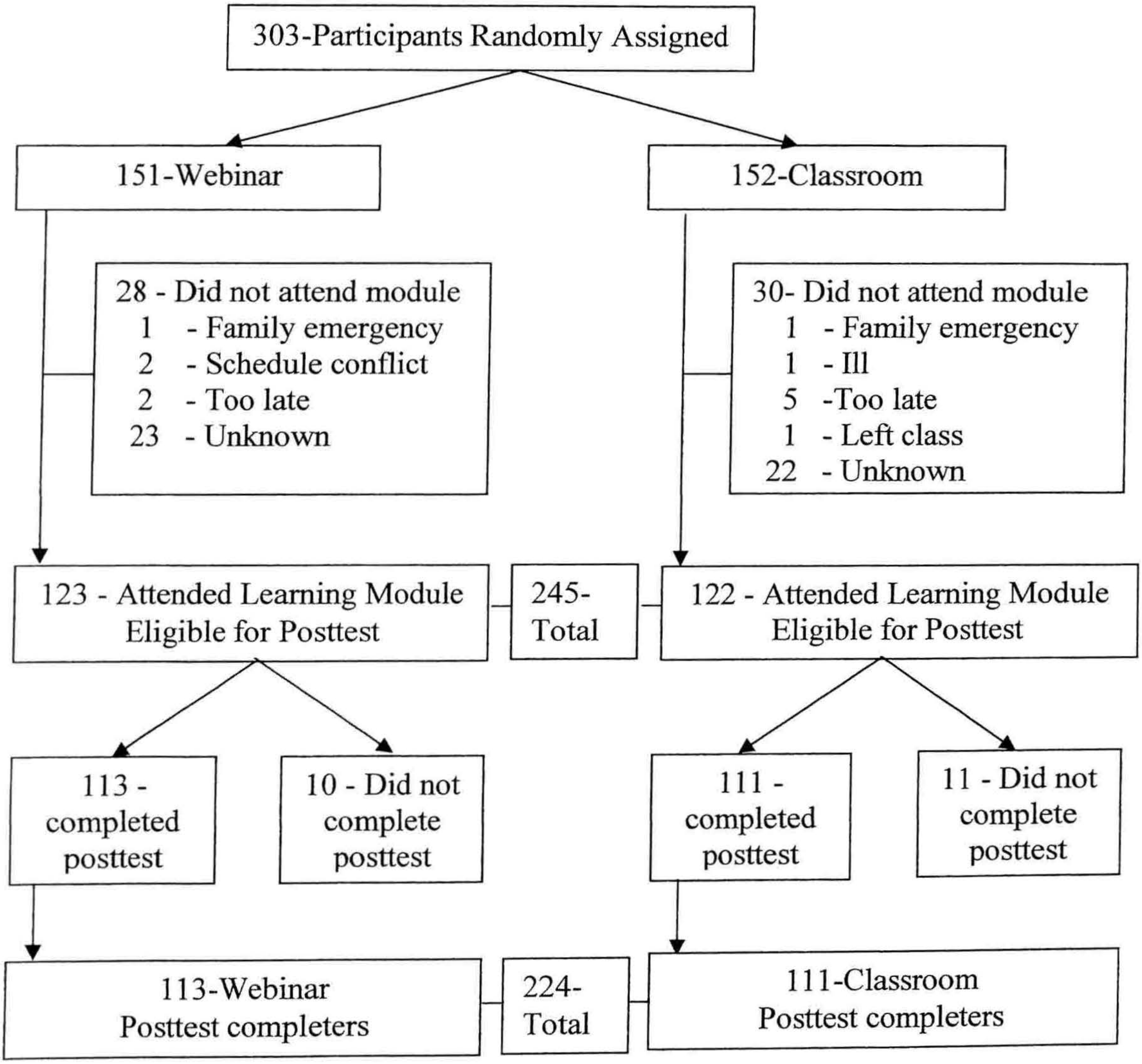

Figure 1. Participant flow chart.

Findings

Hypothesis Tested

H_A: Baccalaureate student nurses who were randomly assigned to attend a 30 minute learning module entitled "Thinking Critically about Acid-Base Balance" delivered by webinar would score higher on a posttest administered immediately after the module compared to baccalaureate student nurses who were randomly assigned to receive the learning module via classroom instruction.

Data Analysis

Frequencies and histograms were computed to screen for data entry errors, to assess outliers, and to assess normalcy. Nine scores of zero were noted in the data file. The test development company was contacted to review these scores to assess individual test responses. It was determined that these individuals did not answer all the questions on the posttest and therefore were awarded a score of zero by the computerized scoring system. Although scores for these participants were manually calculated a decision was made to exclude these scores from data analysis because not all questions had been attempted. The webinar group had 6 of the 9 zero scores and the classroom group had three.

An independent *t*-test and Levene's test for homogeneity was then conducted. The Levene's test was statistically significant, $F\ (2, 222) = 4.102, p = .044$, indicating a lack of homogeneity despite random assignment. The lack of homogeneity precluded use of the Student independent *t*-test. A Welch's *t*-test was therefore performed, $t\ (215.8) = 0.251,\ p = .40$. Based on an alpha of .05, and a one-tailed test, the research hypothesis was not supported. Baccalaureate student nurses randomly assigned to attend a 30 minute learning module entitled “Thinking Critically about Acid-Base Balance” delivered by webinar did not score higher than baccalaureate student nurses randomly assigned to classroom instruction. In fact, there was no statistically significant difference noted between the groups. Cohen’s $d = 0.03$ indicating an extremely small effect size (Polit & Beck, 2008). See Table 3 for a comparison of means, standard deviations, and minimum and maximum scores for each group.

Table 3

Comparing Webinar to Classroom Instruction

Modality	*N*	*M*	*SD*	Minimum Score	Maximum Score
Webinar	113	902.19	264.082	302	1400
Classroom	111	894.06	218.506	399	1329

The data with the nine excluded scores included were analyzed for any changes in homogeneity or hypothesis testing results. Homogeneity problems persisted and the *t*-test result was also non-significant. Exclusion of these scores did not impact the outcome.

Summary of the Findings

A two-group experimental posttest only study was conducted with 224 randomly assigned baccalaureate nursing students to determine the differential effect of a 30 minute learning module delivered by webinar versus classroom instruction. The independent variable was the teaching modality (i.e., webinar versus classroom) and the dependent variable was learning outcomes as measured by the score achieved on an online proctored 30 minute posttest developed by Elsevier HESI® Testing. The final sample consisted of 113 in the webinar and 111 in the classroom group.

Despite random assignment Levene's test for homogeneity was statistically significant indicating a lack of homogeneity between the webinar and classroom groups. A Welch's *t*- test was therefore conducted with no significant difference noted between the groups. The research hypothesis was not supported. Baccalaureate student nurses randomly assigned to attend a 30 minute learning module entitled "Thinking Critically about Acid-Base Balance" delivered by webinar did not score higher than baccalaureate student nurses randomly assigned to classroom instruction. Discussion of the study's findings follows in the next chapter.

CHAPTER V

SUMMARY OF THE STUDY

There is increased pressure in both universities and in the business community to use online methods for adult education. Advantages include reductions in travel time and the associated costs, convenience, and the expanded reach of the educational session made possible by the availability of a computer and a stable internet connection (Colvin Clark & Kwinn, 2007). In the past, asynchronous technologies have dominated distance education programs. Technology has now progressed to include increasing use of synchronous technologies, such as webinars. A webinar is an online real-time interactive presentation between a teacher and learners who are geographically separated. One has only to perform a brief search of the web to note the large number of webinars or online seminars available. Platforms such as Adobe Acrobat Connect Professional®, Wimba Classroom®, Elluminate Live®, and WebEx® are increasingly being utilized by universities to offer synchronous classroom experiences (Schullo, et al., 2007), yet research on the effectiveness of this instructional modality is lacking. If evidence is to drive educational practice, research conducted with sufficient rigor is needed. This 2-group experimental, posttest only study was designed to provide beginning evidence for webinar effectiveness compared to the traditional classroom. The following hypothesis was tested:

H_A: Baccalaureate student nurses who were randomly assigned to attend a 30 minute learning module, delivered by webinar, would score higher on a posttest administered immediately after the learning module compared to baccalaureate student nurses who were randomly assigned to receive the learning module via classroom instruction.

Summary

After approval by the institutional review board, 303 baccalaureate nursing students in different semesters of the nursing program were randomly assigned to receive an optional learning module for additional course credit, by webinar or classroom instruction. The independent variable was the modality (i.e., webinar versus classroom) and the dependent variable was the learning outcome as measured by the score on a 30 minute online proctored posttest. The study design and procedures focused on minimizing possible threats to internal validity (Polit & Beck, 2008). The webinar and classroom sessions were offered on the same day, 5 minutes apart, to minimize opportunities for group exchange of information. Webinar participants received the learning module in a classroom with individual computers and audio/voice headsets and classroom participants in a regular classroom without computers. Both groups were taught by the researcher using the same PowerPoint lecture. Study protocols were closely followed to ensure that both groups received equal attention. The posttest was conducted in a separate computer classroom. Selecting “agree” on the online posttest acknowledgement screen constituted informed consent. A total of 245 students completed the learning module and of those 224 completed the posttest. The final sample therefore consisted of 113 webinar and 111 classroom participants.

Discussion of Findings

Threats to Internal Validity

In conducting the study, the researcher attempted to minimize threats to internal validity. Internal validity is the degree to which it can be inferred that the experimental treatment (i.e., webinar versus classroom instruction) rather than uncontrolled extraneous factors caused the observed outcome (Polit & Beck, 2008). Threats to internal validity in this study were a significant Levene's test, instrumentation, the unknown impact on scores of a timed posttest not impacting course grades, and the potential impact of pre- versus post-lunch scheduling on posttest scores.

The homogeneity threat. The intent of randomization is to ensure that variables that might impact research outcomes are evenly distributed between the experimental and control group. Though randomization is the most trustworthy and acceptable method of equalizing groups, as stated by Polit and Beck (2008), "there is no *guarantee* that the groups in fact will be equal" (p. 254). In this study Levene's test of homogeneity was significant suggesting that the webinar and classroom groups, despite randomization, were not homogeneous. Within each group there were differences on the dependant variable which necessitated the use of a different *t*-test statistic (i.e., Welch's *t*-test) to accommodate the threat of unequal variances.

The effect of heterogeneity of variance on alpha was also explored as recommended by Glass and Hopkins (1984). Sample sizes were similar (i.e., webinar N = 113, classroom N = 111). Variance was calculated for both groups and it was noted that the larger variance was paired with the slightly larger webinar group. The implications were that statistical testing was actually conducted at an alpha slightly less than .05, representing a potential for a slight increase in a Type II error. A Type II error occurs when the null hypothesis is accepted when it is false (Polit & Beck, 2008). No difference is reported when a difference actually exists. In this study use of the Welch's *t*-test also reduced the degrees of freedom slightly, however, this had no impact on the p-value of .40, regardless of the *t*-test used. Heterogeneity did not appear to change the outcome.

Instrumentation. A Cronbach's alpha of .66 in part reflects the overall difficulty of the posttest items. When a test is very easy or very difficult there is little differentiation within or between groups and reliability is lower (Crocker & Algina, 1986). An aggregate item analysis provided by Elsevier HESI® Testing for over 2800 uses of these items had higher reliability (K-R 20 = .72) and a balanced range of item difficulty (5 low, 13 moderate, and 5 difficult). As well point biserials were generally higher ranging from .15 - .57. These statistics reinforce that reliability is not simply a function of items, but rather "it is the property of the scores on a test for a particular group of examinees" (Crocker & Algina, 1986, p. 144). The posttest items were designed for nursing students who are preparing for the NCLEX-RN® and were written at the application level. For this group of participants, composed of students at various points in the nursing program, the majority of the items were moderately difficult. Though point biserials would be lower as a result, only 5 items were lower than the standard of .15 (Varma, 2010) and 20 of the 25 items were greater than the higher standard suggested by McGahee and Ball (2009) of .20.

The reliability of the posttest would have been increased by a longer test. Using the Spearman Brown Prophecy formula and assuming the addition of items parallel in content and difficulty to the original test, increasing the items from 25 to 35 would have increased reliability to .73 (Crocker & Algina, 1986). Based on the testing standard of the National Council of State Boards of Nursing application level items require 1.36 minutes per item. An increase to 35 items would have necessitated a posttest of 48 minutes, which would have exceeded the time participants were available.

Course grade and scheduling impact. The length of time spent on the posttest by each participant is calculated as part of the online testing format. There was concern that since the posttest results would not affect the course grade that participants might rush completion and that this might negatively impact the scores achieved. In a *t*-test comparing the time spent in posttest completion at an alpha of .05, there was no significant difference in the groups, $t\ (222) = 0.280$, $p = .780$, (webinar $M = 20.76$ minutes, classroom $M = 20.59$ minutes). As seen in Table 4, the percentiles and minimum maximum time spent were also similar. If time was a factor it was the same for each group.

Table 4

Time Spent on Posttest

Modality	M	SD	Minimum-Maximum Time	25th P	50^{th} P	75^{th} P
Webinar	20.76	4.398	11-30	17.00	20.00	24.50
Classroom	20.59	4.493	10-30	18.00	21.00	24.00

An additional concern was that the pre-lunch timing for the webinar group might have a negative impact on posttest scores. In terms of posttest completion time, the webinar group did not spend any more time on the posttest and though not statistically significant the webinar group had a slightly higher mean than the classroom group (M = 902.19, M = 894.06 respectively). It is unknown if webinar participants would have scored even higher if tested post-lunch.

Comparing Results to Published Research

No published empirical research was identified that compared learning outcomes achieved via webinar versus classroom instruction. In the analysis of current research from 2003 onward, synchronous research focused on comparing knowledge outcomes (i.e., the score on an exam, the course grade) achieved via synchronous chat versus to face-to-face chat and generally identified no significant difference (Buckley, 2003; Dennis, 2003; Hansen 2008). A webinar includes synchronous chat but includes more opportunity for live student-teacher interaction as the educational content is also delivered in real time. This study addressed a gap in education research and provides beginning evidence, based on the lack of significant difference (p = .40), that the webinar modality was at least as effective as classroom instruction in achieving learning outcomes in this sample of undergraduate nursing students.

This study, through use of the experimental method and a sample size of 224, also addresses the methodological limitations identified in the meta-analyses of distance education compared to the traditional classroom (Bernard et al., 2004; Lou et al., 2006) and in a subsequent review of individual studies. With a sample of 224 (webinar 113 and classroom 111), an alpha of .05, and a directional hypothesis, the power to detect a small effect size of 0.30 was .74 (Lipsey, 1990).

Research Fit with the Conceptual Model

Participants in this study were adult learners at various points in their progression through a baccalaureate nursing program who received a learning module by webinar or by classroom instruction. As stated in Chapter 1, the andragogy in practice model was chosen for this study because it is a "transactional model of adult learning that is designed to transcend specific applications and situations" (Knowles et al., 2005, p. 143). The variation in concept exposure prompted a simple to complex teaching strategy with the ultimate goal being that participants would internalize the principles of acid-base balance to allow success in application level posttest questions. Based on a situational analysis, it was anticipated that the first semester participants would have lower scores due to limited prior concept exposure and to the immediacy of the testing but that randomization would mitigate this effect in the modality comparison. Based on the percentile figures seen in Table 5 this would appear to be the case.

Table 5

Score Comparison by Semester

Semester	*N*	*M*	*SD*	Minimum-Maximum Score	25th *P*	50th *P*	75th *P*
1st semester	76	747.59	234.18	315-1248	578.00	753.50	913.25
2nd semester	32	957.53	199.10	594-1368	794.75	960.00	1067.00
3rd semester	69	951.12	206.20	459-1254	790.50	962.00	1122.50
4th semester	47	1023.49	211.92	302-1400	901.00	1064.00	1175.00

An acceptable level of performance on Elsevier HESI® tests is 850, however, the recommended level is 900 (Evolve Reach Testing and Remediation, 2010). Particularly for participants in the first semester additional instruction is needed to ensure a firm grasp of this complex subject.

Conclusions and Implications

In this study there was no significant difference in learning outcomes, as measured by a score on a posttest administered immediately after the learning module, in 224 baccalaureate nursing students randomly assigned to webinar versus classroom instruction. Concerns over internal validity prompted the decision to have webinar participants receive the webinar at the university instead of a location of chosen by the participants, as would normally occur with this modality. Results must be viewed within this context. An additional concern is that given the immediacy of the posttest that what is being tested is recall not learning. This remains a possibility, however, the posttest was designed to test concept application and application is a skill generally requiring more than simple recall. Although generalizability is limited to the study context and to the study population of undergraduate nursing students, the following implication can be elicited: webinar instruction is as effective as classroom instruction in achieving learning outcomes.

Recommendations for Further Study

Given the paucity of current research, multiple possibilities exist for expanding research on the webinar modality. Some possibilities include:

1. Test a lengthened comparison period: Compare webinar to classroom instruction throughout an undergraduate nursing course. Lectures could be offered via webinar and via classroom with all other course components kept the same. This would address the issue of recall versus learning.
2. Test different webinar locations: Learning outcomes in a webinar offered in a university setting could be compared with a webinar taken at home, in undergraduate nursing students. This would address other ways a webinar is offered.
3. Test other outcomes and broaden research methods: Other possibilities include using a mixture of quantitative and qualitative methods in research with undergraduate nursing students who are receiving webinar lectures to measure learner satisfaction and perceptions of learning or to compare learning styles and course grades.
4. Test graduate and staff nurse populations: Other groups could include masters or doctoral level nursing students or staff nurses receiving staff education.

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APPENDIX A
Learning Module Protocol

Topic: Thinking Critically About Acid-Base Balance

Objectives	Taxonomy Level	Content	Teaching Strategy
1. identify the key components of acid-base balance.	Factual and Remembering	1. What is pH? • Measure of acidity or alkalinity. • pH scale 1-14, with 1 acid and 14 base. 2. What is a normal pH for the body? • 7.35 to 7.45 • < 7,35 Acid; > 7.45 base. • Neutral range of scale. • Maintain in range for normal function. 3. What affects pH in the body? • Level of H+, HCO_3, and CO_2. • H+ (acid), HCO_3 (base), CO_2 (acid). 4. How is normal balance maintained? • Kidney: Works slowly, continuously, affects HCO_3. • Lungs: Works rapidly. Affects CO_2. • Examples of balancing by kidney and lung based on too much acid, too much base. 5. What are normal values for pH, CO_2, HCO_3?	PowerPoint lecture, interspersed with questions to assess understanding. 2. Four Questions on pH: acid, base, or normal. 3. Questions: General impact on patient of loss of H+, HCO_3, CO_2. 4. Questions: Impact on breathing of pH. 5. Handout of normal values to reference. Powerpoint lecture, interspersed with application.
2. Distinguish between the four major acid-base disorders.	Conceptual and Understanding	1. Define Respiratory Acidosis • Breathing too slowly. • Increased CO_2 (more acid) > 45 • pH falls into acid range <7.35. • Why: any condition that causes hypoventilation. 2. Define Respiratory Alkalosis • Breathing too fast. • Blowing off CO_2 (more base). < 35 • pH rises into base range > 7.45. • Why: any condition that causes hyperventilation.	1. & 2. Practice identifying respiratory acidosis versus respiratory alkalosis, using Normal (N), Acidosis (A) and Alkalosis (B) technique., e.g. if pH is acid and CO_2 is up (acid) = respiratory acidosis.

Con't

<table>
<tr><th>Objectives</th><th>Taxonomy Level</th><th>Content</th><th>Teaching Strategy</th></tr>
<tr><td></td><td></td><td>3. Define Metabolic Acidosis
• HCO_3 is low (more acid) = < 22.
• pH falls into acid range < 7.35.
• Why: Body conditions
  o Too much acid- e.g.diabetic ketoacidosis.
  o Loss of base- e.g. diarrhea

4. Define Metabolic Alkalosis
• HCO_3 is high (more base) = >26.
• pH rises into base range > 7.45.
• Why: Body conditions.
  o Too much base, e.g. ingestion of antacids.
  o Loss of acid, e.g. vomiting.</td><td>3 & 4. Practice identifying metabolic acidosis versus metabolic alkalosis, as indicated under 1 & 2.</td></tr>
<tr><td>3. Apply acid-base balance principles to blood gas analysis.</td><td>Conceptual and application</td><td>1. Three steps to analyze reviewed.
• 3 blood gas examples.

2. Compensation
• Defined: attempt to fix by system, not causing the problem.
• Review of 2 examples of partial compensation.</td><td>Practice with 3 blood gas examples.</td></tr>
<tr><td>4. Correlate clinical conditions with alterations in acid-base.</td><td>Conceptual and application</td><td>1. Conditions that Impact Breathing
• Respiratory acidosis= not breathing enough.
  o Head/spinal injury; drugs (sedatives, narcotics); pulmonary disorders; hypoventilation for any reason (pain, abdominal distention).
• Respiratory alkalosis = blowing off CO_2.
  o Head injury; drugs-aspirin overdose; pulmonary disorders; hyperventilation due to pain, anxiety, fever.

2. Gaining or losing acid or base.
• Metabolic acidosis:
  o Gained acid: kidney failure, diabetic ketoacidosis, starvation, aspirin overdose.
  o Lost base: diarrhea,</td><td>PowerPoint lecture followed by scenario-based application.</td></tr>
</table>

Con't

Objectives	Taxonomy Level	Content	Teaching Strategy
		intestinal fistulas. • Metabolic alkalosis: o Gained base: ingestion of anti-acids, bicarbonate. o Lost acid: diuretics, excessive vomiting, gastric suction.	
		3. Clinical Scenarios • Patient who is over sedated and not breathing. • Patient who is in respiratory distress with a high respiratory rate. • Pulmonary Patient on a ventilator having frequent stools.	3. To answer two questions: • What is acid-base disorder? • What is likely cause of disorder?

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APPENDIX B
Protocol for the Conduct of Education Modality

Classroom

1. The classroom was opened 15 minutes prior to the scheduled start time.
2. Participants were welcomed as they entered the classroom and asked to sign in on the attendance sheet. Attendance was required for course credit.
3. The researcher did introductions and reviewed the plan for the session: a 30 minute learning module, followed by a 30 minute online multiple choice timed posttest.
4. Any questions were answered and the learning module begun.
5. Upon completion of the learning module the participants reviewed the cover letter, and an opportunity for questions was provided.
6. Willing participants were then taken to the exam classroom for the proctored online posttest.
7. Participants were advised that selecting "agree" on the acknowledgment screen constituted informed consent.
8. In keeping with standard examination procedure, all cell phones were turned off, and all books or reference materials were placed at the back of the classroom.
9. The normal values for blood gas analysis (PaO_2, pH, CO_2, HCO_3) were projected on a screen in the exam classroom. Participants were given a blank piece of paper to use as they deemed fit during the exam.
10. Participants were reminded that they had 30 minutes to complete the test from the start time and at the end of 30 minutes they would be required to submit the test, regardless of completion.
11. The participants were then given the group code (Class) and an identification number to access the exam.
12. At the end of the 30 minute period the posttest was submitted and the blank piece of paper was collected.
13. Participants were thanked for their participation and given a certificate of attendance.
14. Participants were also given the opportunity to fill out their name for a drawing to occur at the end of the research, for one of 10 gift cards from a local store.

Webinar

1. The computer classroom was opened 15 minutes prior to the scheduled start time.
2. Participants were welcomed as they entered the classroom and asked to sign in on the attendance sheet. Attendance was required for course credit.
3. The research assistant instructed the participants as they entered the classroom to follow the written procedure for logging on to WebEx® beside each computer. Information technology was present to assist with any connection or set-up problems.

4. The researcher did introductions online and reviewed the plan for the session: a 30 minute learning module, followed by a 30 minute online multiple choice timed posttest.
5. Any questions were answered and the learning module begun.
6. Upon completion of the learning module the participants reviewed the cover letter, and an opportunity for questions was provided.
7. Willing participants were then taken to the exam classroom for the proctored online posttest.
8. Participants were advised that selecting "agree" on the acknowledgment screen constituted informed consent.
9. In keeping with standard examination procedure, all cell phones were turned off, and all books or reference materials were placed at the back of the classroom.
10. The normal values for blood gas analysis (PaO_2, pH, CO_2, HCO_3) were projected on a screen in the exam classroom. Participants were given a blank piece of paper to use as they deemed fit during the exam.
11. Participants were reminded that they had 30 minutes to complete the test from the start time and at the end of 30 minutes they would be required to submit the test, regardless of completion.
12. The participants were then given the group code (Webinar) and an identification number to access the exam.
13. At the end of the 30 minute period the posttest was submitted and the blank piece of paper was collected.
14. Participants were thanked for their participation and given a certificate of attendance.
15. Participants were also given the opportunity to fill out their name for a drawing to occur at the end of the research, for one of 10 gift cards from a local store.

APPENDIX C

Instrument

Central to the success of the study was having a valid and reliable instrument to measure learning outcomes. A decision was therefore made to seek the assistance of Elsevier HESI® Testing, a company experienced in the development of test items based on an NCLEX-RN® blueprint. Classical test theory is the foundation of HESI® item design and the validity and reliability of Elsevier HESI® specialty exams and exit exams is well established (Morrison, Adamsons, Nibert, & Hsia, 2006). For this study, Elsevier HESI® Testing developed a custom online exam, derived from items in the Elsevier HESI® database that fit with the selected content and learning objectives. Though the exam developed was not tested as a whole prior to use, each exam item had been previously tested on baccalaureate nursing students. The parameters used by HESI® to judge item quality include a cumulative difficulty level of "no less than 40% and a point biserial correlation of 0.15 and above" (Morrison et al., 2006, p. 42S).

Given the propriety nature of the posttest, the actual test items cannot be included for review. The posttest was a 25 item multiple choice test written at the application level to simulate the testing standard of the National Council of State Boards of Nursing. Based on that standard, 1.36 minutes per question was required. Please see a sample below of the type of question that the participants may have encountered:

1. The patient has a diagnosis of respiratory failure and is currently on a ventilator. On assessment the patient is noted to be short of breath, with a respiratory rate 28, and pulse of 100. ABGs are: PaO_2 of 65, CO_2 of 30, HCO_3 24, pH 7. 48. The acid-base disorder is:
a. Metabolic acidosis.
b. Metabolic alkalosis.
c. Respiratory acidosis.
d. Respiratory alkalosis.

2. The patient is on a morphine drip for pain control. His saturation monitor has dropped to 89% from 95%. He is difficult to arouse, respirations are 12/minute and his pulse is 80. An ABG is drawn and the results are as follows: PaO_2 of 65, CO_2 54, HCO_3 22, pH 7.30. Choose all that are correct:
a. This is respiratory acidosis.
b. This is metabolic acidosis.
c. **The patient is oversedated.**
d. The patient is resting.

Morrison, S., Adamson, C., H., Niber, A., & Hsia, Susan. (2006). HESI exams: An overview of reliability and validity. *Computers, Informatics, Nursing, and Nurse Educator, 22*(4), 220-226.

APPENDIX D

Institutional Review Board Approval

TWU
TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

Office of Research
6700 Fannin Street
Houston, TX 77030-2343
713-794-2480 Fax 713-794-2488

March 2, 2010

Ms. Leslie Nelson
College of Nursing - J. McFarlane
6700 Fannin Street
Houston, TX 77030

Dear Ms. Nelson:

Re: *"Learning Outcomes of Webinar versus Classroom Instruction among Baccalaureate Nursing Students: A Randomized Controlled Trial"*

The above referenced study has been reviewed by the TWU Institutional Review Board (IRB) and was determined to be exempt from further review.

Any changes in the study must receive review and approval prior to implementation unless the change is necessary for the safety of subjects. In addition, you must inform the IRB of adverse events encountered during the study or of any new and significant information that may impact a research participant's safety or willingness to continue in your study.

Sincerely,

John Radcliffe, Chair
Institutional Review Board - Houston

APPENDIX E

Agency Approval

[redacted]

TO: Texas Woman's University, IRB Committee

FROM: Dr. [redacted] Baccalaureate Coordinator, [redacted]

RE: Leslie Nelson, MN research entitled: "Learning Outcomes of Webinar versus Classroom Instruction Among Baccalaureate nursing students: A Randomized Controlled Trial"

This letter is to convey that I will facilitate the proposed research study by Leslie Nelson, entitled, "Learning Outcomes of Webinar versus Classroom Instruction Among Baccalaureate nursing students: A Randomized Controlled Trial". This study will compare learning outcomes achieved via webinar versus classroom instruction in undergraduate nursing students. Online education is increasing as an instructional modality. Data on learning outcomes will be analyzed as part of the research project and will not impact course grades. As undergraduate coordinator, I will facilitate Ms. Nelson's efforts to complete her research a[redacted]

Sincerely,

[redacted]

[redacted]

Program Coordinator, Baccalaureate Nursing

[redacted] University, College of Nursing, [redacted]

APPENDIX F

Recruitment: Posting on Blackboard®

There was a link on Blackboard® entitled, "Learning Module: Thinking Critically about Acid-Base Balance", with the following description:

Blood gas analysis is an important skill. This is a learning module focused on acid-base balance that includes practice in blood gas analysis. Here are the full objectives for the module.

By the end of the presentation you will be able to:

1. Identify the key components of acid-base balance.
2. Distinguish between the four major acid-base disorders.
3. Apply acid-base balance principles to blood gas analysis.
4. Correlate clinical conditions with alterations in acid-base, based on clinical scenarios.

Upon completion you will be credited with [insert course credit as determined by faculty]. The learning module will be taught by Leslie Nelson, MN.

PLEASE NOTE: The class has been divided into two sections. Please attend the assigned section to receive credit. Please see the list below to see which section you have been assigned.

Group A: Date & time: __________ Classroom: ________________________

- ___________________________
- ___________________________
- ___________________________
- ___________________________
- ___________________________
- ___________________________

Group B: Date & time: __________ Classroom: ________________________

- ___________________________
- ___________________________
- ___________________________
- ___________________________
- ___________________________
- ___________________________

If you have any questions regarding this learning module please contact Leslie Nelson, MN at [phone number] or via email at [email].