International Journal of Aviation, Aeronautics, and Aerospace

Volume 9 | Issue 1 Article 5

2022

Medium Altitude Long Endurance RPA Training: Evaluating Blended Learning

Zachary Waller
University of North Dakota, zachary.waller@und.edu
Robert Stupnisky
University of North Dakota, robert.stupnisky@und.edu

Scholarly Commons Citation
Waller, Z., & Stupnisky, R. (2022). Medium Altitude Long Endurance RPA Training: Evaluating Blended Learning. *International Journal of Aviation, Aeronautics, and Aerospace, 9*(1). https://doi.org/10.15394/ijaaa.2022.1650

In 2003, Osguthorpe and Graham situated their understanding of blended learning according to aspects of both modality (i.e., the mode of delivery) and pedagogy (i.e., the method of teaching). Since then, assessments of blended learning at the course-level have established its effectiveness through comparison to traditional models – commonly construed as face-to-face (Porter et al., 2014; Waller et al., 2016).

Statement of the Problem

Between 2011 and 2017 the “Science and Technology for Warfighter Training and Aiding” cooperative agreement between the University of North Dakota and the Air Force Research Laboratory (AFRL) produced curriculum for Medium Altitude, Long Endurance Remotely Piloted Aircraft (MALE RPA) pilots and sensor operators. From these efforts was developed a Heads Down Display (HDD) Menu Trainer as a stand-alone software trainer to familiarize students with the layout and manipulation of the HDD menus for either the MQ-1 or MQ-9.

Preliminary work by Waller et al. (2016) established the efficacy of this HDD menu trainer in improving student performance from pretest to posttest scores across several modalities (i.e., traditional, blended, and distance). Waller et al. also noted that participants with greater levels of Federal Aviation Administration (FAA) pilot certification scored significantly higher on the pretest measure of the HDD Menu Trainer but lacked a sufficient sample to assess FAA pilot certification as a covariate.

Data collection across the curriculum, rather than within a course, was needed to assess whether student performance across modalities would begin to differ when the model allowed FAA pilot certification to covary.

Purpose of the Study

The purpose of this study was to assess whether student performance with the HDD Menu Trainer would differ across modalities (traditional, blended, and distance) when FAA pilot certification was allowed to covary in the analysis. Students were sampled across several classes within a curriculum, rather than within a course.

Literature Review

Measures such as (1) student evaluations and satisfaction (Horsch et al., 2000; Hsu & Hsieh, 2011; Smyth et al., 2012), (2) student performance and achievement, (Allen et al., 2004; Baumlin et al., 2000; Bell et al., 2000; Block et al., 2008; Boyle et al., 2003; Curran et al., 2000; Engel et al., 1997; Francis et al., 2000; Harris et al., 2001; Kronz et al., 2000; Lipman et al., 2001; Melton et al., 2009; Perryer et al., 2002; Rivera & Rice, 2002; Rose et al., 2000; Sakowski et al., 2001; Woo & Kimmick, 2000), the Sloan-C Pillars (Laumakis et al., 2009), and even the confidence of students (Pereira et al., 2007) have all seen use in situating instructional models (face-to-face, blended, and online) according to modality.

As the adoption of blended learning progressed, proponents predicted it would become the 'new normal' within higher education (Norberg et al., 2011). Accepting the course-level effectiveness of blended learning, the sections below review institutions and administrations seeking a better understanding of how blended learning might be strategically implemented at scale.

University of Granada, Spain

Among the first examples aggregating data across curriculums is a blended learning initiative evaluated by Lopez-Perez et al. (2011) at the University of Granada, Spain. First year undergraduate students (n = 985) – enrolled in Business Administration and Management, Economics Business Studies, and the Business Administration/Law courses – provided their perceptions of the courses via a 13-item survey (Lopez-Perez et al., 2011). The students' performance was also measured by (1) the proportion of students sitting the final exam (the 'non-dropout rate') and (2) the proportion of passing grades (Lopez-Perez et al., 2011).

Results indicated that blended learning reduced dropout rates and increased exam passing rates (Lopez-Perez et al., 2011). A comparison of regression models indicates that students' motivation during the face-to-face portion of their blended course were predictive of their final grade ($p< 0.01$), over and above the variation explained by their age, gender, average grade prior to entering the course, and attendance (Lopez-Perez et al., 2011). Lopez-Perez et al. (2011) offer that the motivation, satisfaction, and perceived utility of blended learning may influence student performance in an indirect way.

University of Central Florida, United States

Moskal et al. (2013) assess the performance of blended learning efforts at the University of Central Florida (UCF). With an interest in improving teaching and informing institutional policymaking, Moskal et al. investigated how student satisfaction, success, and withdrawal related to course modality (i.e. blended, fully online, face-to-face, blended lecture capture, and lecture capture). Course ratings from academic years 2008 to 2011 were indexed by modality (Moskal et al., 2013).

A large sampling (n = 913,688) of student satisfaction reflected "… the blended modality [enjoyed] the highest percentage (52%) of "excellent" responses producing a 4% marginal advantage over online and face-to-face courses that [were] tied at 48%..." (Moskal et al., 2013). From this finding, the university used regression tree analysis to identify aspects of the instructor and course which lead to an overall rating of 'excellent' (Moskal et al., 2013).

The analysis of Moskal et al. (2013) found that if UCF students rated the instructor's (1) ability to facilitate learning, (2) communication skill, and (3) respect and concern for students as 'excellent', the probability of the course receiving an overall rating of 'excellent' moved to .97 – regardless of the modality. Encouraged by this finding, Moskal et al. conducted a hierarchical logistic regression indicating that over and above the predictive power of demographic characteristics associated

DOI: https://doi.org/10.15394/ijaaa.2022.1650

with students, the addition of these three instructor qualities is able to increase R^2 by 0.719. Regardless of modality, which does not enter the model, these three items are proposed as high-impact areas for improving pedagogy (Moskal et al., 2013).

When student rates of success – measured as earning a passing grade – and withdrawal were evaluated against modality, courses in the blended learning category yielded the highest success rates of 90.8% and saw withdrawal at roughly half the rate (2.8%) of lecture capture courses (5.3%) (Moskal et al., 2013).

York University, Canada

At York University, Owston et al. (2013) examined the relationship between student perceptions and achievement in blended learning courses. Following a multi-year initiative to increase blended learning, students (n = 577) were surveyed from eleven (11) blended learning courses. In an Analysis of Covariance (ANCOVA) model, responses to a 31-item survey were entered as the independent variables, cumulative grade point averages (CGPA) were entered as a covariate, and final grade for the blended coursework was entered as the dependent measure of achievement (Owston et al., 2013).

Results indicated higher achievement (i.e. a final grade) for students who strongly agreed with the statements 'I am satisfied with this [blended] course' and 'I would take another blended course' – $F(4,448) = 12.69$, $p = .000$, $\eta^2 = .102$ and $F(5,447) = 6.30$, $p = .000$, $\eta^2 = .066$, respectively, with the estimated marginal mean of final grades corrected for CGPA. Owston et al. (2013) conclude, "… that the highest achievers were most satisfied with their blended course, would take one again, and preferred the blended format over fully face-to-face or online [courses]" (p. 41). The opposite was found for low achieving students.

Further results from the ANCOVA model indicated that high achieving students found that blended learning offered (1) convenience, and (2) reduced travel time and expenses – $F(5,445) = 6.37$, $p = .000$, $\eta^2 = .067$ and $F(5,443) = 5.56$, $p = .000$, $\eta^2 = .059$, respectively (Owston et al., 2013). When assessing the relationship between engagement in blended learning and achievement, the largest effect was found in responses to the statement asking whether students were engaged more in their current blended course than other face-to-face courses they had taken, $F(5,444) = 15.99$, $p = .000$, $\eta^2 = .153$ (Owston et al., 2013). All but one of the twelve Likert statements related to engagement indicated significant differences between high and low achievers. For the inquiry related to students' perceptions of learning, Owston et al. (2013) relay a significant relationship between responses to the statement 'Compared to typical face-to-face courses I have taken… this course has improved my understanding of key concepts', $F(5,446)= 6.38$, $p= .000$, $\eta^2 = .067$.

Following York University's implementation of a major blended learning initiative, Owston et al. (2013) offer, "high achievers are very satisfied with the blended format, find blended learning to be convenient and flexible, are very engaged in their studies, and appear to learn key concepts better" (p. 43). The endorsement supports the university's interests with the caveat from Owston et al. that blended courses may not be as suitable for low achievers.

While several of the higher-education efforts above were funded internally, some noted grant support from the NGLC awarded jointly to the American Association of State Colleges and Universities (AASCU) and the University of Central Florida (UCF) (Porter et al., 2014), or a Sloan fluency/localness grant awarded to the University of Wisconsin–Milwaukee (UWM) (Graham et al., 2013).

Methodology

The present study examined the impact of modality (traditional, blended, or distance) in learning the HDD menus of a MALE RPA while controlling for FAA pilot certification. Using the HDD Menu Trainer developed under the "Science and Technology for Warfighter Training and Aiding" cooperative agreement between the Air Force Research Laboratory and the University of North Dakota, pretests and posttests were used to measure learner knowledge gain.

Sample

The sample for this study consisted of individuals both with and without FAA pilot certification at the University of North Dakota John D. Odegard School of Aerospace Sciences (n=102). Of this sample, 26 participants held no FAA pilot certificate, 48 participants held a Private Pilot certificate, and 27 participants carried Commercial Pilot certification. Average age was 22.93 (SD=5.68).

Participants were assigned to modality groups (i.e., traditional, blended, and distance) by class, with each class receiving various instructional interventions for teaching the Heads Down Display (HDD) Menus of the MQ-9. When participants are randomly assigned among groups, the hopeful result are groups which are equivalent on all relevant participant characteristics. When confounds are identified, a covariate can be designated to statistically control for (or partial out) the variance which it explains (Warner, 2012); the effect of FAA pilot certification on HDD menu trainer performance in the results below is one such confound and has been controlled by allowing it to covary in the mixed factorial ANCOVA model. This accounts for the variance attributable to FAA pilot certification between groups.

Instrument

The HDD Menu Trainer, developed by UND, was designed to familiarize students with the layout and manipulation of the HDD menus for either the General Atomics MQ-1 or MQ-9. The trainer contains (1) a tutorial describing menu layout, menu navigation, button types, and button arrangement, (2) a walk-through function, which guides students through each root menu and its submenus, (3) an exercise function, which tests the student's ability to navigate and execute specific commands within a set time limit, and finally (4) a freeplay function, which allows students to navigate and explore the HDD menus without specific focus or limits on time.

https://commons.erau.edu/ijaaa/vol9/iss1/5
DOI: https://doi.org/10.15394/ijaaa.2022.1650

The menu trainer was delivered to the distance and blended groups via an open source, online Learning Management System (LMS). All participants had access to the LMS for completion of the pretest and posttest measures. Participants were briefed on use of the LMS at the start of the intervention.

The pretest and posttest measures utilized a modified version of the HDD Menu Trainer's exercise function. Designed by an Original Equipment Manufacturer (OEM) certified MQ-9 instructor pilot, these assessments represented those menu functions most commonly used or most critical for gauging a student's expertise with navigating and manipulating the HDD menus. Remote pilot orientated menu functions were selected as the pretest and posttest from the trainer's 260 exercise functions, the same set of tasks were used for both the pretest and posttest measures. As with the trainer's exercise function, the student's ability to navigate and execute specific commands within a set time limit were assessed. Performance was measured according both the speed and accuracy of the student's response.

Data Collection and Analysis

This study was reviewed and approved by the applicable Institutional Review Board. Participants were informed of the study with advertisements posted throughout the campus aerospace facilities as well as the aviation student email listserve. Participants were briefed on the purpose and nature of the study prior to participation. Due to the sensitive nature of the MQ-9 HDD Menus, participants were also required to present proof of U.S. citizenship by means of a passport, and/or birth certificate and driver's license and sign an International Traffic in Arms Regulations (ITAR) Statement of Understanding.

The variety of modalities examined in this study were delivered during existing aviation courses, and random assignment among the groups should not be assumed. Preliminary work has indicated that pilot certification significantly affects pretest performance. To mitigate possible effects of this convenience sampling, participant level of FAA pilot certification (i.e., not certificated or certificated) has been controlled wherever performance is assessed across modalities.

Each modality group received instruction on navigating and manipulating the HDD menus of the MQ-9. Illustrated in Table 1 below, students of the distance group were only granted access to the HDD Menu Trainer. Students of the blended group were granted access to the HDD Menu Trainer, but also attended a classroom discussion guided by an OEM certified MQ-9 Instructor Pilot (IP). Students assigned to the traditional group were not granted access to the HDD Menu Trainer, but rather received a lecture and simulator lesson on the HDD menus from an OEM certified MQ-9 IP. To ensure the same menu structure was represented in the instruction of the Traditional group and the pretest and posttest measures, the freeplay function of the HDD Menu Trainer was utilized in the simulated lesson.

The version of the HDD Menu Trainer provided for this purpose had only freeplay functionality, the tutorial, walk-through, and exercise functions were disabled.

Table 1
Research Design

	Traditional Group	Blended Group	Distance Group
HDD Menu Trainer	Freeplay Only	Full	Full
MQ-9 Instructor Pilot	Yes	Yes	No

Results

Illustrated in Table 2 are descriptive statistics for each of the three groups in their pretest, posttest, and percent change measures. Each of 25 tasks in the parallel pretest and posttest measures was assigned 15 possible points. Points were deducted from a maximum score of 375 for incorrect keystrokes as well as when a task could not be completed inside 30 seconds. If a task was skipped, a score of 0 was assigned. Percent change was calculated as the difference between the pretest and posttest score divided by the pretest score.

While significant departures from normality were noted among each of the pretest, posttest, and percent change distributions in the Kolmogorov-Smirnov and Shapiro-Wilk tests, the F statistic has been found to be robust against such violations. Included in Table 2 are z-scores for the skewness and kurtosis of each factor's score distribution. For these measures, absolute values greater than 1.96 represent significantly non-normal distributions at $p<0.05$ (Field, 2009). Because parametric assumptions may not be considered tenable, the results of the inferential procedures that follow should be interpreted with caution. The descriptive statistics of Table 2 are uncorrected for the covariate.

DOI: https://doi.org/10.15394/ijaaa.2022.1650

Table 2
Descriptive Statistics for Student Performance

	N	Mean	SD	Min	Max	Z skew.	Z kurt.
PRE-TEST							
Traditional	39	203.95	69.47	63.00	324.00	-0.85	-0.80
Blended	29	210.80	60.72	103.00	311.00	-0.04	-1.31
Distance	30	235.24	70.86	14.00	326.00	-2.64**	2.03*
POST-TEST							
Traditional	39	271.26	71.98	45.00	365.00	-3.67***	2.20*
Blended	29	289.40	45.30	195.00	371.00	-1.02	-0.71
Distance	30	287.62	72.84	13.00	373.00	-4.82***	7.35***
PERCENT CHANGE							
Traditional	39	43.60	48.44	-75.41	183.05	2.79**	3.04**
Blended	29	48.42	48.57	-15.67	192.23	2.78**	2.15*
Distance	30	25.98	30.19	-15.63	111.39	2.60**	0.98

* Indicates significance at the .05 level
** Indicates significance at the .01 level
*** Indicates significance at the .001 level

An independent samples *t*-test (see Table 3) was used to compare the hours of self-study reported by students of the distance (M = 1.25, SD = 1.00) and blended (M = 1.22, SD = 1.51) modalities. Students in both of these groups had remote access to the HDD menu trainer, while members of the traditional group did not. Results indicated no difference in amounts of self-study between students in the blended and distance groups $t(54)=-0.08$, *ns*.

Table 3
Comparison of Self-Reported Hours of Study

	n	***M (SD)***	**Mean Difference**	***t***	***df***
Modality					
Blended	30	1.22 (1.52)	-0.03	-0.08	54
Distance	26	1.25 (1.00)			

Performance across Modality

Results of a mixed factorial ANCOVA analyzed variation unique to modality (traditional, blended, and distance) while controlling for whether or not a student held an FAA pilot certificate. In functional notation, the procedure is set as follows below:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_1X_2 + b_5X_1X_3 + \varepsilon$$

Where

Y = A student's ability to navigate and manipulate the HDD menu trainer - ranging between 0 and 375.

X_1 = A within-subjects measure of performance, evaluated at 0 (pretest) and 1 (posttest).

X_2 = A between-subjects measure of modality, evaluated across three modalities (i.e. traditional, blended, and distance).

X_3 = A covariate for FAA pilot certification, evaluated at 0 (not FAA certificated) and 1 (FAA certificated).

X_1X_2 = The interaction effect between Performance and Modality ($X_1 * X_2$)

X_1X_3 = The interaction effect between Performance and Pilot Certification ($X_1 * X_3$)

Results of this procedure are shown in Table 4, indicating the effectiveness of the HDD menu trainer through a main within-subjects effect of performance $F(1,93)=27.65$, $p<.001$. That is, regardless of modality – and controlling for pilot certification – posttest scores were higher than pretest scores. A significant between-group main effect of pilot certification $F(1,93)=3.97$, $p<.05$ was also noted, however, neither of the interaction effects were found to be significant.

Table 4

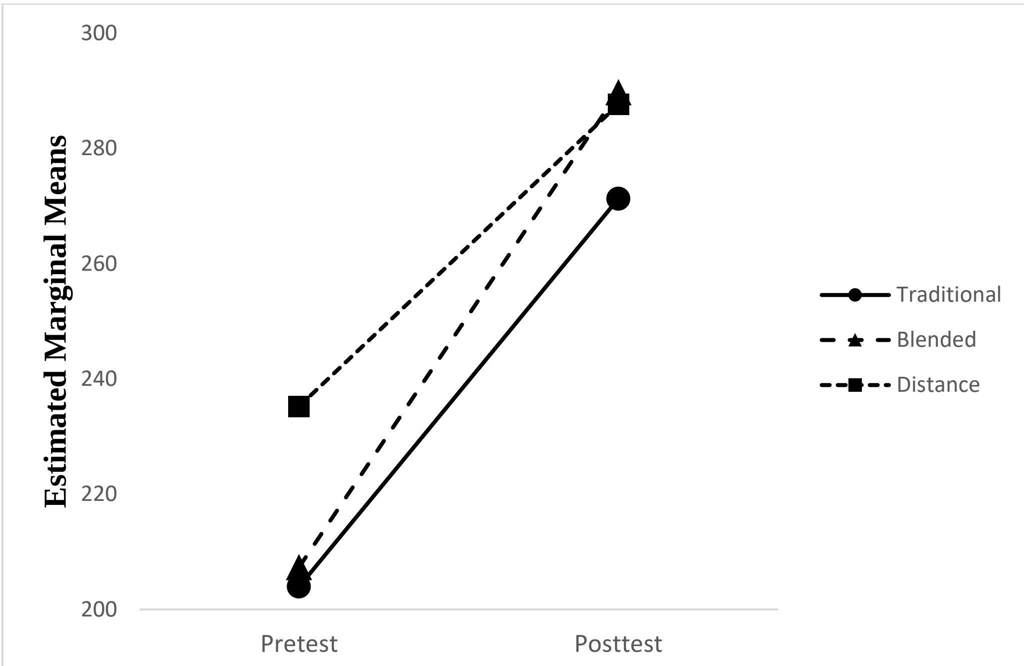
Regressing Performance across Modality (Pilot Certification Controlled)

	df	**MS**	***F***	**η^2**
Performance	1	45212.63	27.65***	.23
Modality	2	3896.21	0.56	.01
Pilot Certification	1	27550.44	3.97*	.04
Performance * Modality	2	3396.18	2.07	.04
Performance * Pilot Certification (Covariate)	1	299.83	0.18	.00
Error (Performance)	93	15203.25		
Error	93	6939.72		

* Indicates significance at the .05 level
** Indicates significance at the .01 level
*** Indicates significance at the .001 level

Figure 1 plots estimated marginal means with the FAA pilot certification covariate, which ranges between 0 (not certificated) and 1 (certificated), evaluated at a value of 0.74. Here, modality failed to demonstrate a significant interaction effect with student performance from pretest to posttest.

Figure 1
Estimated Marginal Mean Performance by Modality



Discussion and Conclusion

This study sampled students across a curriculum to assess whether student performance with the HDD Menu Trainer would differ across modalities (i.e. traditional, blended, and distance) when FAA pilot certification was controlled. Waller et al. (2016) noted that students holding pilot certification scored higher in some aspects of the HDD Menu Trainer. Here, whether a student holds an FAA pilot certification is entered as a covariate to control for these differences and better isolate variation which may be attributed to modality. Once again, the HDD Menu Trainer demonstrates (1) an ability to improve student ability in navigating and manipulating the HDD menus for the MQ-9 and (2) a significant between-subjects main effect on performance for students holding an FAA pilot certificate. Neither pilot certification nor modality was found to have a significant interactive effect on student performance.

Prior work assessing blended learning applications has spanned several countries and disciplines. Like many of these works (Allen et al., 2004; Baumlin et al., 2000; Bell et al., 2000; Block et al., 2008; Boyle et al., 2003; Curran et al., 2000;

Engel et al., 1997; Francis et al., 2000; Harris et al., 2001; Kronz et al., 2000; Lipman et al., 2001; Melton et al., 2009; Perryer et al., 2002; Rivera & Rice, 2002; Rose et al., 2000; Sakowski et al., 2001; Woo & Kimmick, 2000), this study compared modalities using student performance and achievement. Like many of these, this study found its blended learning application to be at least as effective as other modalities.

Lopez-Perez et al. (2011) utilized several regression models to better isolate the effect of motivation during the face-to-face portion of a blended learning experience, and Moskal et al. (2013) utilized a hierarchical logistic regression to explain the effect of three instructor qualities – over and above the predictive power of students' demographic characteristics. As Owston et al. (2013) would enter cumulative grade point averages as an ANCOVA model covariate, so this study sought to increase the sensitivity of its model by designating a covariate of its own related to student performance. The ANCOVA results above affirm that even outside the variation which should be attributed to a student's pilot certification, the HDD Menu Trainer demonstrates equal effectiveness when used in blended and distance modalities.

Future Directions

Blended learning has long been situated in terms of both modality and pedagogy (Osguthorpe & Graham, 2003). As the blended learning model undergoes ongoing assessment and increasing integration within higher education, interests have begun to pivot toward goals such as (1) enhancing pedagogy and increasing access (Graham et al., 2005), (2) more efficient use of classroom resources and extending campus outreach (Graham et al., 2005; Moskal et al., 2013), or even (3) adapting the educational paradigm for "… the 'new type of learner' enrolling at the university" (Carbonell et al., 2013).

Having so reviewed strategic integration of instruction which "… combines face-to-face with distance delivery systems…" (Osguthorpe & Graham, 2003, p. 227), a brief treatment of transitions to technology-assisted instruction which have not been strategic is also warranted on behalf of educational technology and instructional design scholars. The term 'emergency remote teaching' has recently emerged as a way to distinguish the mandatory transition that many institutions implemented to prevent the spread of the virus that causes COVID-19 (Hodges et al., 2020). Where modality alone would closely associate the emergency remote teaching of Hodges et al. (2020) or the HyFlex model explained by Irving (Irvine, 2020) with blended learning, proponents are already separating the three on pedagogical terms (Saichaie, 2020).

Although discussion – or perhaps more accurately – clarification surrounding modality has resurged with emergency remote teaching, the future directions of inquiry specific to blended learning appear to be focusing increasingly on the student engagement (Borup et al., 2020; Halverson & Graham, 2019). The study of this construct – its measurement and supporting mechanisms – are well situated as blended, flipped, and hybrid learning models are increasingly expected within higher education curriculum all around the globe (Saichaie, 2020).

References

Allen, M., Mabry, E., Mattrey, M., Bourhis, J., Titsworth, S., & Burrell, N. (2004). Evaluating the effectiveness of distance learning: a comparison using meta-analysis. *Journal of Communication*, *54*, 402–420.

Baumlin, K., Bessette, M., Lewis, C., & Richardson, L. (2000). EMCyberSchool: An evaluation of computer-assisted instruction on the internet. *Academic Emergency Medicine*, *7*, 959–962.

Bell, D., Fonarow, G., Hays, R., & Mangione, C. (2000). Self-study from web-based and printed guidline materials: A randomized controlled trial among resident physicians. *Annals of Internal Medicine*, *132*, 938–946.

Block, A., Felix, M., Udermann, B., Reineke, D., & Murray, S. (2008). Achievement and satisfaction in an online versus a traditional health and wellness course. *Journal of Online Learning and Teaching*, *4*, 57–66.

Boyle, T., Bradley, C., Chalk, P., Jones, R., & Pickard, P. (2003). Using blended learning to improve student success rates in learning to program. *Journal of Educational Media*, *28* (2&3).

Carbonell, K. B., Dailey-Hebert, A., & Gihselaers. (2013). Unleashing the creative potential of faculty to create blended learning. *Internet and Higher Education*, *18*, 29–37.

Curran, V., Hoekman, T., Gulliver, W., Landells, I., & Hatcher, L. (2000). Web-based continuing medical education (II): Evaluation study of computer-mediated continuing medical education. *The Journal of Continuing Education in the Health Profession*, *20*, 106–119.

Engel, S., Crandall, J., Basch, C., Zybert, P., & Wylie-Rosett, J. (1997). Computer-assisted diabetes nutrition education increases knowledge and self-efficacy of medical students. *The Diabetes Educator*, *23*, 545–549.

Field, A. (2009). *Discovering statistics using SPSS.* Sage.

Francis, B., Mauriello, S., Phillips, C., Englebardt, S., & Grayden, S. (2000). Assessment of online continuing dental education in North Carolina. *The Journal of Continuing Education in the Health Profession*, *20*, 76–84.

Graham, C., Allen, S., & Ure, D. (2005). Benefits and challenges of blended learning environments. In *M* (pp. 253–259). IGI Global.

Graham, C., Woodfield, W., & Harrison, B. (2013). A framework for institutional adoption and implementation of blended learning in higher education. *Internet and Higher Education*, *18*, 4–14.

Harris, J., Salasche, S., & Harris, R. (2001). Can internet-based continuing medical education improve physicians' skin cancer knowledge and skills? *Journal of General Internal Medicine*, *16*, 50–56.

Horsch, A., Balbach, T., Melnitzki, S., & Knauth, J. (2000). Learning tumor diagnostics and medical image processing via the WWW - The case-based radiological textbook ODITEB. *International Journal of Medical Informatics*, *58–59*, 39–50.

Hsu, L.-L., & Hsieh, S.-I. (2011). Effects of a blended learning module on self-reported learning performances in baccalaureate nursing students. *Journal of Advanced Nursing*, 2435–2444.

Irvine, V. (2020). The landscape of merging modalities. *EDUCAUSE Review*, *55*(4).

Kronz, J., Silberman, M., Jr., A., W., & Epstein, J. (2000). A web-based tutorial improves practicing pathologists' gleason grading of images of prostate carcinoma specimens obtained by needle biopsy: Validation of a new medical education paradigm. *The American*

Cancer Society, *89*(8), 1818–1823.

Laumakis, M., Graham, C., & Dziuban, C. (2009). The Sloan-C pillars and boundary objects as a framework for evaluating blended learning. *Journal of Asynchronous Learning Networks*, *13*(1), 75–87.

Lipman, A., Sade, R., Glotzbach, A., Lancaster, C., & Marshall, M. (2001). The incremental value of internet-based instruction as an adjunct to classroom instruction: A prospective randomized study. *Academy of Medicine*, *76*(10), 72–76.

Lopez-Perez, M., Perez-Lopez, M., & Rodriguez-Ariza, L. (2011). Blended learning in higher education: Students' perceptions and their relation to outcomes. *Computers and Education*, *56*, 818–826.

Melton, B., Graf, H., & Chopak-Foss, J. (2009). Achievement and satisfaction in blended learning versus traditional general health course designs. *International Journal for the Scholarship of Teaching and Learning*, *3*, 1–13.

Moskal, P., Dziuban, C., & Hartman, J. (2013). Blended learning: A dangerous idea? *Internet and Higher Education*, *18*, 15–23.

Norberg, A., Dziuban, C., & Moskal, P. (2011). A time based blended learning model. *On the Horizon*, *19*(3), 207–216. https://doi.org/http://dx.doi.org/10.1108/10748121111163913

Osguthorpe, R., & Graham, C. (2003). Blended learning environments: Definitions and directions. *The Quarterly Review of Distance Education*, *4*(3), 227–233.

Owston, R., York, D., & Murtha, S. (2013). Student perceptions and achievement in a university blended learning strategic initiative. *Internet and Higher Education*, *18*, 38–46.

Pereira, J., Pleguezuelos, E., Meri, A., Molina-Ros, A., Molina-Tomas, C., & Masdeu, C. (2007). Effectiveness of using blended learning strategies for teaching and learning human anatomy. *Medical Education*, *41*, 189–195.

Perryer, G., Walmsley, A., Barclay, C., Shaw, L., & Smith, A. (2002). Development and evaluation of a stand-alone web-based CAL program. *European Journal of Dental Education*, *4*(3), 118–123.

Porter, W., Graham, C., Spring, K., & Welch, K. (2014). Blended learning in higher education: Institutional adoption and implementation. *Computers and Education*, *75*, 185–195.

Rivera, J., & Rice, M. (2002). A comparison of student outcomes & satisfaction between traditional & web based course offerings. *Online Journal of Distance Learning Administration*, *5*.

Rose, M., Frisby, A., Hamlin, M., & Jones, S. (2000). Evaluation of the effectiveness of a web-based graduate epidemiology course. *Computers in Nursing*, *18*, 162–167.

Sakowski, H., Rich, E., & Turner, P. (2001). Web-based case simulations for a primary care clerkship. *Academic Medicine*, *76*(547.).

Smyth, S., Houghton, C., Cooney, A., & Casey, D. (2012). Sutdents' experiences of blended learning across a range of postgraduate programmes. *Nurse Education Today*, *32*, 464–468.

Waller, Z., Petros, T., Bridewell, J., Kroeber, S., & Nowatzki, N. (2016). Medium altitude long endurance remotely piloted aircraft training: A pilot study in blended learning. *Journal of Unmanned Aerial Systems*, *1*, 6–16. https://doi.org/10.31356/avi-fac0002

Warner, R. M. (2012). *Applied statistics: From bivariate through multivariate techniques*. Sage.

Woo, M., & Kimmick, J. (2000). Comparison of internet versus lecture instructional methods for teaching nursing research. *Journal of Professional Nursing*, *16*, 132–139.