COMFORT LEVEL IN AN UNDERGRADUATE RESEARCH METHODS COURSE WITH MULTIPLE TEACHING MODALITIES: IMPACT ON SELF-EFFICACY

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ABSTRACT

This study is a follow-up to an earlier study (LeBlanc, 2006) which investigated the outcomes of teaching techniques on students' sense of comfort in performing research related tasks in an undergraduate research methods course. In the original study, the author tested students' perceptions of levels of comfort in performing research related tasks at the beginning and end of the semester over several semesters in a face-to-face modality. In the current study, pre- and post-course data from a span of nineteen years in the same course, by the same instructor, with different modalities (face-to-face, hybrid, and fully online) are compared to examine if changes in student reports of comfort with research tasks occur across time and by modality. Results indicated a significant increase in student perceptions of comfort with performing research tasks from beginning to end of the course term for all three teaching modalities, with minor variances between the modalities.

INTRODUCTION

Research methods courses may be required for undergraduate students in communication at many universities. The rationale offered at our university for requiring the course is the belief of many faculty that graduates' abilities to critically analyze claims about statements in general, and communication claims in particular, are of paramount importance. This local rationale is in line with the National Communication Association's (2015) learning outcome in communication (LOC #5): critically analyze messages. Additionally, faculty hold as important graduates' abilities to construct credible claims and indeed may be a necessary learning outcome for the program and university (see Winn, 1995) and discipline (National Communication Association, 2015, LOC #4). To be sure, the credibility of an undergraduate program may be tied, in the minds of employers, to the ability of its graduates to perform specific tasks in a measurably reliable way.

However, despite the goals of faculty, students in communication may experience anxiety and trepidation towards the subject matter, especially when the course involves quantitative or statistical analysis. Fear towards engaging in the tasks involved for achieving research methods related learning outcomes may have deleterious effects on undergraduate students and their motivation to learn how to critically analyze and create credible claims. As well, the teaching approach or modality (face-to-face, online, or hybrid of the two) may also have differential effects on learning outcomes. The purpose of this study is to investigate whether the teaching approach

and/or teaching modality can have a positive effect on student comfort level with performing research-related tasks from beginning to end of the semester.

REVIEW OF LITERATURE

Learning Objectives in Undergraduate Research Methods

As cited in LeBlanc (2006), requiring undergraduate students in the social sciences to take a research methods course, while not universal, is fairly common (Thies & Hogan, 2005). A major goal of liberal arts education, including the social and behavioral sciences, is to provide opportunities for students to learn the skills necessary to think critically. One method for providing that opportunity is the undergraduate research methods course. In the home Communication department of this author, a course in research methods is a requirement of the degree, with the stated learning objective of producing credible consumers and producers of information.

There may be multiple approaches employed when teaching research methods to achieve this learning objective. Research in the area, particularly as it applies to the research methods course has been reported over the last several decades. For example, McBurney (1995) suggested that instructors who utilize a pragmatic problem-based approach could achieve the overall course goal of training students to construct more credible claims. McBurney (1995) argued instructors wishing students to learn critical thinking skills should engage students in all aspects of the research process including students making choices about topic, research questions or hypotheses, and method of observation and data collection.

While research may not be a career goal of undergraduate students, the purpose of including a research methods course in a program may be more obvious to instructors. According to Dingman (2021), students may or may not become researchers as a career choice. However, engagement with the research process teaches students to become critical about information they receive. When instructors make research skill development more explicit to undergraduate students, students begin to see themselves as researchers (Willison & Buisman-Pijlman, 2016). According to Bjørkvold and Ryen (2021), when students are researchers, they develop a sense of autonomy and individuality. Students' increased sense of autonomy and individuality may be associated with increases in self-efficacy

Self-efficacy

Self-efficacy was first defined by Bandura as the person's belief in his or her own ability to complete tasks (Bandura, 1977). Self-efficacy as a sense of one's own abilities could be influenced by the particular task at hand. Tasks deemed difficult by the individual may differentially influence self-perceptions compared to tasks deemed easy. Science or math related academic tasks are often deemed difficult.

Prior knowledge about a required research methods course may elicit anxiety among students. According to Perepiczka et al. (2011), statistics anxiety and attitudes towards statistics are strong predictors of self-efficacy to learn statistics among graduate students. It is likely the case that the same relationship exists for undergraduate students who are first being introduced to statistics and statistical thinking in a research methods course. This pre-course anxiety may be increased by outside factors. For example, during the COVID-19 pandemic students' mathematics related anxiety increased due to the switch to remote learning (Mendoza et al., 2021).

Anxiety can work against achievement of learning outcomes by students. According to Yang et al. (2021), learning outcomes are most significantly influenced by students' internal motivation which can be increased through strategies that encourage curiosity and active learning. Hong et al. (2021) demonstrated that personality characteristics of students that enhance self-efficacy can reduce academic performance anxiety. Active-learning strategies (learning by doing) used in an introductory methods course lead students to ask more sophisticated questions, engage in the material, and become more open to ideas that may challenge pre-existing beliefs (Scheel, 2002). Burns et al. (2021) suggest that reducing anxiety related to science tasks while promoting self-efficacy in those tasks might increase student achievement.

Skills-based Learning

Kirschner et al. (2006) argued that guided instruction is superior to unguided, inquiry-based approaches to teaching. However, Hmelo-Silver et al. (2007) found that inquiry-based learning using scaffolding techniques are important for training students in self-directed learning. Additionally, Jiang and McComas (2015) found that inquiry-based instruction increased student openness to and positive attitudes toward science and inquiry. The authors also found that inquiry-based instruction has stronger outcomes compared to direct instruction, contrary to the findings of Kirschner et al. (2006).

Minner et al. (2010) also demonstrated strong support for inquiry-based approaches particularly when those approaches are used to improve student critical thinking and "drawing conclusions from data." The authors described inquiry-based approaches as involving multiple stages in scientific inquiry including a) developing the question, b) developing the study design, c) developing the data collection procedures, d) analyzing data and making conclusions, and e) communicating study outcomes. Minner and colleagues (2010) also demonstrated how inquiry-based approaches can have positive effects on student motivation within the affective domain such as interests, involvement, curiosity, enthusiasm, and perseverance.

According to Bjørkvold and Blikstad-Balas (2017), engaging in the research process, particularly writing about research findings, are viewed as relevant to future careers requiring initiative among seventh graders. These findings suggest that undergraduate students can be motivated to engage in all aspects of the research process, including data analysis. Participation in research skill development among undergraduate students leads to more autonomy and satisfaction even for those students who do not go on to graduate studies (Willison & O'Regan, 2007).

Utilizing a variety of assignments and pragmatic approaches involving incremental steps in the research process leads to reduced anxiety among students (Dobratz, 2003). Irish (1987) argued that assignments should be structured into easily mastered research sub-skills (see also Maier & Curtin, 2004; Scheel, 2002; cited in LeBlanc, 2006). Maier and Curtin (2004) argued that student self-efficacy in research methods is increased when research tasks are scaffolded. Successfully mastering of each sub-skill leading up to the final project increases students' sense of accomplishment. Scaffolding research assignments from beginning of the research process to an end goal helps students engage in problem-solving exercises (Maier & Curtin, 2004; McBurney, 1995; Winn, 1995; Clark, 1999).

According to Brown-Kramer (2021), higher-utility learning strategies, such as spaced practice, are positively correlated with course performance. This suggests that scaffolding research tasks in a distributed fashion through the semester towards an end-of-semester final research project may contribute to better outcomes. As students learn more about the research process, their confidence in the ability to accomplish research tasks may improve. This may be particularly true if students conduct research within their own discipline. According to Vittengl and Vittengl (2021), students who complete data analysis within the context of a course within their own departments demonstrate better learning outcomes compared to students who are sent to other departments to learn data analysis.

Earlier researchers (see Winn, 1995; Clark, 1999) suggested that research methods courses which do not require data analysis on individual student projects may be sufficient in teaching research methods to undergraduate students. As Winn (1995) argued, requiring a completed project increases the amount of time required by faculty to grade such assignments and therefore may be impractical. Recent developments in technology may render that argument moot. More recent research suggests that requiring data collection and analysis in an undergraduate course has other post course benefits for students. For example, students that learn how to analyze data using software specifically designed for such tasks, including data visualization, may see the results of their work in ways that they can connect to personally.

Research Methods and Course Modality

During the COVID-19 pandemic, teaching modalities shifted significantly from face-to-face to online modalities (see LeBlanc, 2021). This modality shift should have occurred for most lecture-based courses, including undergraduate research methods. However, it is possible that online modalities for research methods courses existed pre-pandemic. The questions are whether there existed a modality effect or a COVID effect, or some interaction between these two contexts on students' perceptions of their work in undergraduate research methods courses.

A students' connection to their own work can be accomplished in research methods courses regardless of modality. The question for this study is whether self-efficacy increases over time from beginning to end of the semester as a consequence of reduction of anxiety towards research related tasks or conversely through an increase in comfort-level toward those research tasks over time. Both online and offline interactive learning approaches resulted in better learning outcomes

for students compared to traditional passive learning approaches (Wang et al., 2021). Kim and Lee (2021) found that graduate students engaged in research projects using digital technologies had significantly higher outcomes than students who were not actively engaged in research projects using digital technologies.

These results may be a function of instructor use of technologies and engagement with students. According to Yu (2021), the intermittent presence of the instructor in videos used in asynchronous online learning more significantly improves learning outcomes compared to full presence and non-presence. Regardless, use of these digital technologies for instruction may contribute to student self-efficacy if utilized appropriately. For example, Leary and Ness (2021) found that the use of "e-lectures" allows for sustainability of instruction that can be "re-used" by students in an asynchronous online course, which may be of particular importance during a pandemic. As well, hybrid modalities where part of the course is online while part of the course is offered face-to-face may provide different opportunities for faculty to engage students in research activities. According to Sánchez et al. (2021), flipped learning is a strategy that is most likely to be employed in teaching topics including language and mathematics in secondary and higher education. The hybrid classroom provides more opportunity for instructors to use the flipped classroom methodology. This technique might be particularly useful in teaching undergraduate research methods when face-to-face meetings could be organized around "coaching" research skills development.

In a previous study on comfort-level of undergraduate students in performing research-related tasks, LeBlanc (2006) demonstrated that undergraduate students comfort level performing research tasks increased between the beginning and ending of several sections of a research methods face-to-face course. To determine if these findings hold across different teaching modalities, the following hypothesis is proposed:

H_1 Students will report increases in comfort in performing research tasks between the beginning and end of a research methods course across and between three teaching modalities.

As noted above, LeBlanc (2006) previously demonstrated an increase in students' comfort level in a research methods class. An instructor may have learned and applied new approaches over time when teaching the same course. Additionally, changes in student preparedness for research methods may have occurred over time, particularly if there have been changes to university admissions policies. To determine if there have been changes over time in student level of comfort with research tasks with the instructor, the following research question is proposed:

RQ_1 Will students report increases in comfort in performing research tasks between the beginning of the instructor's teaching career in the subject and currently?

LeBlanc (2021) demonstrated a small but significant reduction in students' perceptions of instructors' teaching between pre- and post-COVID. Part of the reduction in evaluations of instructors may have been due to the rapid transition to online learning which occurred in Spring 2020, as students may have been more experienced with face-to-face teaching modality compared to synchronous or asynchronous online teaching modalities. To determine if there have been

changes in student level of comfort with research tasks pre- and post-COVID, the following research question is proposed:

RQ$_2$ Will students report decreases in comfort in performing research tasks between pre-COVID hybrid or online courses and post-COVID online courses?

METHODS

The study procedures were reviewed by the local Institutional Review Board in November 2020 (IRB # FY20-21-49) and determined the study did not meet requirements for federally regulated research, was exempt from human subjects' protections and required no further IRB oversight.

Subjects

The participants were 490 students in 21 distinct sections of an undergraduate research methods course in Communication at a large research extensive school in the southwestern United States. Average class size was 25 students ($M = 23.33$, $sd = 8.13$). Students took these courses from the same instructor over a twenty-year span from 2001 to 2021. Twelve sections were taught utilizing face-to-face modality ($n = 324$ students), 4 sections utilizing hybrid modality ($n = 76$), and 5 sections utilizing fully online modality ($n = 90$). Of the 490 students in the study, 53.5% ($n = 262$) claimed to have previously conducted research, 67.8% ($n = 332$) claimed to have previously served as a research participant, and 3.5% did not answer either question ($n = 17$). A test of differences between researchers and participants among students revealed that significantly more students who participated in research also conducted research compared to students who have not served as a research participant, $\chi^2(1) = 11.959$, $p < .001$, $\varphi = .159$ (see Table 1 below). Only those students who completed both the pre-test and post-test survey were included in the paired-samples analyses ($n = 187$).

TABLE 1. COMPARISON OF STUDENTS WHO HAVE PREVIOUSLY CONDUCTED RESEARCH VERSUS THOSE WHO HAVE SERVED AS PARTICIPANTS

		Conducted Research				Total
		Yes		No		
		N	%	N	%	
Research Participant	Yes	201	42.5%	131	27.7%	332
	No	61	12.9%	80	16.9%	141
Total		262	55.4%	211	44.6%	473

Instrument

Data for the study were gathered using the Research Comfort Level Inventory (RCLI) which was developed by the author for the course in 2001. The RCLI contained 10 five-point Likert type statements regarding specific steps in the research process from selecting a topic for research (statement 1) to discussing findings (statement 10). Participants were asked to rate their relative level of comfort with performing the specific research task from very uncomfortable (1) to very comfortable (5). The RCLI was administered during the first (pre-test) and last (post-test) weeks of a course term. Principal Components Analysis was performed to determine if there were underlying factors among the ten items of the instrument for each of the pre- and post-test conditions, presuming inter-item correlation for comfort-level of performing various research-related tasks. For the pre-test condition, the reliability of the RCLI the pre-test condition was sufficiently high (α = .886) with all ten items influencing the outcome (the range of Cronbach's alpha scores if item deleted was .868 - .882). For the post-test condition, the reliability of the instrument was very high (α = .922) with all ten items influencing the outcome (the range of Cronbach's alpha scores if item deleted was .910 - .923).

Procedure

All students in each section were requested to complete the RCLI during the first week of classes (pre-test). Students were informed that the survey was to be used to assist the instructor in making adjustments to the course and that the data may be presented publicly. They were told that the survey results were ungraded. At the end of the term, students were asked to complete the RCLI again and that the data from the survey would be compared to the data collected at the beginning of the term. Participation was voluntary. Analyses were conducted using IBM® SPSS® Statistics, Version 28.

RESULTS

The first hypothesis was partially supported. Post-class average Research Comfort Level (M = 3.90, sd = .79, $S.E.$ = .06, N = 187) was significantly higher than pre-class average Research Comfort Level (M = 3.25, sd = .72, $S.E.$ = .05, N = 187) for paired responses for all classes surveyed (n = 19) across the 20-year span, $t(186)$ = -8.981, p < .001, Cohen's d = -.657. These statistically significant increases held across all ten items, see Tables 2 and 3 below.

To determine whether having prior experience conducting research affected research comfort level, a Repeated Measures ANOVA was performed on the average of the pre-class research tasks compared to the average of the post-class tasks across prior experience conditions (yes or no). Results indicated that having prior experience conducting research had no significant between-subjects effect on the comfort level of subjects. Having served as a research participant prior to

the course (yes or no) also had no significant between-subjects effect on the comfort level of subjects.

TABLE 2. SUMMARY STATISTICS FOR PRE- AND POST-TERM RESPONSES TO ITEMS ON THE RCLI FOR ALL TEACHING MODALITIES

Item		N	Mean	Std. Deviation	S.E. Mean
Pair 1	(pre) Selecting Topic	187	3.43	1.03	.08
	(post) Selecting Topic	187	4.05	.97	.07
Pair 2	(pre) Creating Search Plan	186	3.12	1.01	.07
	(post) Creating Search Plan	186	3.94	1.00	.07
Pair 3	(pre) Choosing Search Tools	187	3.10	1.02	.07
	(post) Choosing Search Tools	187	3.99	1.05	.08
Pair 4	(pre) Evaluating Sources	186	3.33	1.05	.08
	(post) Evaluating Sources	186	4.07	1.17	.09
Pair 5	(pre) Citing Internet Sources	187	3.53	1.07	.08
	(post) Citing Internet Sources	187	4.02	1.12	.08
Pair 6	(pre) Organizing Literature Review	186	3.43	1.06	.08
	(post) Organizing Literature Review	186	4.10	1.04	.08
Pair 7	(pre) Developing Hypotheses	187	3.11	1.05	.08
	(post) Developing Hypotheses	187	3.94	1.06	.08
Pair 8	(pre) Developing Methods	187	2.97	.99	.07
	(post) Developing Methods	187	3.73	1.02	.07
Pair 9	(pre) Analyzing Statistics	187	2.94	1.11	.08
	(post) Analyzing Statistics	187	3.27	1.02	.07
Pair 10	(pre) Discussing Findings	187	3.57	1.02	.07
	(post) Discussing Findings	187	3.91	.95	.07

TABLE 3. COMPARISON OF PRE- TO POST-TERM RESPONSES TO ITEMS ON THE RCLI FOR ALL TEACHING MODALITIES

Item	Paired Differences					*t*	*df*	Sig. (2-tailed)	Cohen's *d*
	Mean	Std. Deviation	S.E. Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1 (pre) vs. (post) Selecting Topic -	-.62	1.36	.10	-.82	-.42	-6.24	186	.000	-.456
Pair 2 (pre) vs. (post) Creating Search Plan	-.82	1.32	.10	-1.01	-.63	-8.51	185	.000	-.624
Pair 3 (pre) vs. (post) Choosing Search Tools	-.89	1.46	.11	-1.10	-.68	-8.31	186	.000	-.608
Pair 4 (pre) vs. (post) Evaluating Sources	-.74	1.43	.10	-.95	-.54	-7.08	185	.000	-.519
Pair 5 (pre) vs. (post) Citing Internet Sources	-.49	1.45	.11	-.70	-.28	-4.60	186	.000	-.337
Pair 6 (pre) vs. (post) Organizing Literature Review	-.67	1.36	.10	-.86	-.47	-6.69	185	.000	-.491
Pair 7 (pre) vs. (post) Developing Hypotheses	-.82	1.42	.10	-1.03	-.62	-7.91	186	.000	-.578
Pair 8 (pre) vs. (post) Developing Methods	-.75	1.39	.10	-.95	-.55	-7.40	186	.000	-.541
Pair 9 (pre) vs. (post) Analyzing Statistics	-.33	1.41	.10	-.53	-.12	-3.17	186	.002	-.232
Pair 10 (pre) vs. (post) Discussing Findings	-.34	1.25	.09	-.52	-.16	-3.73	186	.000	-.273

Further analysis was performed to determine if differences in comfort level of performing research tasks occurred between students in classes with different teaching modalities. For face-to-face classes (*n* = 12), post-class average Research Comfort Level (*M* = 3.87, *sd* = .78, *S.E.* = .07, *N* = 129) was significantly higher than pre-class average Research Comfort Level (*M* = 3.15, *sd* = .70, *S.E.* = .06, *N* = 129) for paired responses across the 20-year span, $t(128) = -9.14$, $p < .001$, Cohen's

d = -.804. These statistically significant increases held across all ten items, see Tables 4 and 5 below.

TABLE 4. SUMMARY STATISTICS FOR PRE- AND POST-TERM RESPONSES TO ITEMS ON THE RCLI FOR THE FACE-TO-FACE TEACHING MODALITY

Item		N	Mean	Std. Deviation	S.E. Mean
Pair 1	(pre) Selecting Topic	129	3.33	1.070	.094
	(post) Selecting Topic	129	4.01	.964	.085
Pair 2	(pre) Creating Search Plan	129	3.06	1.029	.091
	(post) Creating Search Plan	129	3.85	1.024	.090
Pair 3	(pre) Choosing Search Tools	129	3.05	1.018	.090
	(post) Choosing Search Tools	129	3.97	1.023	.090
Pair 4	(pre) Evaluating Sources	129	3.26	1.055	.093
	(post) Evaluating Sources	129	4.02	1.173	.103
Pair 5	(pre) Citing Internet Sources	129	3.45	1.053	.093
	(post) Citing Internet Sources	129	3.98	1.086	.096
Pair 6	(pre) Organizing Literature Review	129	3.37	1.061	.093
	(post) Organizing Literature Review	129	4.12	1.000	.088
Pair 7	(pre) Developing Hypotheses	129	3.00	1.053	.093
	(post) Developing Hypotheses	129	3.88	1.053	.093
Pair 8	(pre) Developing Methods	129	2.87	.979	.086
	(post) Developing Methods	129	3.68	.984	.087
Pair 9	(pre) Analyzing Statistics	129	2.68	1.082	.095
	(post) Analyzing Statistics	129	3.31	.983	.087
Pair 10	(pre) Discussing Findings	129	3.43	.999	.088
	(post) Discussing Findings	129	3.91	.922	.081

Post-class Research Comfort Level was significantly higher than pre-class Research Comfort Level for paired responses for some, but not all, research tasks in the hybrid classes surveyed (*n* = 4). In particular, students reported more comfort with creating a search plan at the end of term (*M* = 4.16, *sd* = .96, *S.E.* = .22, *N* = 19) than at the beginning of term (*M* = 3.11, *sd* = 1.15, *S.E.* = .26, *N* = 19), *t*(18) = -2.727, *p* = .014, Cohen's *d* = -.626. Likewise, students reported more comfort with choosing search tools at the end of term (*M* = 4.11, *sd* = 1.20, *S.E.* = .28, *N* = 19) than at the beginning of term (*M* = 2.95, *sd* = 1.22, *S.E.* = .28, *N* = 19), *t*(18) = -2.480, *p* = .023, Cohen's *d* = -.569. However, students reported less comfort with analyzing statistics at the end of the term (*M* = 3.11, *sd* = 1.05, *S.E.* = .24, *N* = 19) than at the beginning of the term (*M* = 3.79, *sd* = .98, *S.E.* = .22, *N* = 19), *t*(18) = 2.477, *p* = .023, Cohen's *d* = -.568. No significant difference was found between the average for all post- and pre-term Research Comfort Level items for hybrid modality classes.

TABLE 5. COMPARISON OF PRE- TO POST-TERM RESPONSES TO ITEMS ON THE RCLI FOR THE FACE-TO-FACE TEACHING MODALITY

Item	Paired Differences					t	df	Sig. (2-tailed)	Cohen's d
	Mean	Std. Deviation	S.E. Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1 (pre) vs. (post) Selecting Topic	-.674	1.336	.118	-.907	-.442	-5.735	128	.000	-.505
Pair 2 (pre) vs. (post) Creating Search Plan	-.791	1.248	.110	-1.008	-.573	-7.196	128	.000	-.634
Pair 3 (pre) vs. (post) Choosing Search Tools	-.915	1.335	.118	-1.147	-.682	-7.783	128	.000	-.685
Pair 4 (pre) vs. (post) Evaluating Sources	-.760	1.368	.120	-.998	-.521	-6.307	128	.000	-.555
Pair 5 (pre) vs. (post) Citing Internet Sources	-.527	1.387	.122	-.769	-.286	-4.317	128	.000	-.380
Pair 6 (pre) vs. (post) Organizing Literature Review	-.752	1.263	.111	-.972	-.532	-6.764	128	.000	-.596
Pair 7 (pre) vs. (post) Developing Hypotheses	-.876	1.369	.121	-1.115	-.637	-7.266	128	.000	-.640
Pair 8 (pre) vs. (post) Developing Methods	-.814	1.351	.119	-1.049	-.579	-6.844	128	.000	-.603
Pair 9 (pre) vs. (post) Analyzing Statistics	-.628	1.281	.113	-.851	-.405	-5.566	128	.000	-.490
Pair 10 (pre) vs. (post) Discussing Findings	-.473	1.173	.103	-.677	-.268	-4.578	128	.000	-.403

For online classes surveyed ($n = 3$) for the 3 year period in which online courses were offered (2017-2020), post-class average Research Comfort Level ($M = 3.99$, $sd = .80$, $S.E. = .13$, $N = 39$) was significantly higher than pre-class average Research Comfort Level ($M = 3.46$, $sd = .65$, $S.E. = .10$, $N = 39$) for paired responses, $t(128) = -2.963$, $p = .005$, Cohen's $d = -.474$. These statistically significant increases held across most of the ten items, see Tables 6 and 7 below.

TABLE 6. SUMMARY STATISTICS FOR PRE- AND POST-TERM RESPONSES TO ITEMS ON THE RCLI FOR THE ONLINE TEACHING MODALITY

Item		N	Mean	Std. Deviation	S.E. Mean
Pair 1	(pre) Selecting Topic	39	3.56	.788	.126
	(post) Selecting Topic	39	4.15	.988	.158
Pair 2	(pre) Creating Search Plan	38	3.32	.842	.137
	(post) Creating Search Plan	38	4.13	.906	.147
Pair 3	(pre) Choosing Search Tools	39	3.33	.898	.144
	(post) Choosing Search Tools	39	4.00	1.100	.176
Pair 4	(pre) Evaluating Sources	39	3.46	.969	.155
	(post) Evaluating Sources	39	4.26	1.093	.175
Pair 5	(pre) Citing Internet Sources	39	3.74	1.044	.167
	(post) Citing Internet Sources	39	4.08	1.156	.185
Pair 6	(pre) Organizing Literature Review	39	3.36	1.158	.185
	(post) Organizing Literature Review	39	4.08	1.036	.166
Pair 7	(pre) Developing Hypotheses	39	3.33	1.060	.170
	(post) Developing Hypotheses	39	4.10	1.021	.163
Pair 8	(pre) Developing Methods	39	3.18	1.023	.164
	(post) Developing Methods	39	3.82	1.023	.164
Pair 9	(pre) Analyzing Statistics	39	3.38	.907	.145
	(post) Analyzing Statistics	39	3.21	1.128	.181
Pair 10	(pre) Discussing Findings	39	3.92	.900	.144
	(post) Discussing Findings	39	4.08	.839	.134

TABLE 7. COMPARISON OF PRE- TO POST-TERM RESPONSES TO ITEMS ON THE RCLI FOR THE ONLINE TEACHING MODALITY

Item	Paired Differences					t	df	Sig. (2-tailed)	Cohen's d
	Mean	Std. Deviation	S.E. Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1 (pre) vs. (post) Selecting Topic	-.590	1.332	.213	-1.022	-.158	-2.765	38	.009	-.443
Pair 2 (pre) vs. (post) Creating Search Plan	-.816	1.373	.223	-1.267	-.365	-3.664	37	.001	-.594
Pair 3 (pre) vs. (post) Choosing Search Tools	-.667	1.545	.247	-1.167	-.166	-2.695	38	.010	-.432
Pair 4 (pre) vs. (post) Evaluating Sources	-.795	1.361	.218	-1.236	-.354	-3.648	38	.001	-.584
Pair 5 (pre) vs. (post) Citing Internet Sources	-.333	1.420	.227	-.794	.127	-1.466	38	.151	-.235
Pair 6 (pre) vs. (post) Organizing Literature Review	-.718	1.521	.244	-1.211	-.225	-2.948	38	.005	-.472
Pair 7 (pre) vs. (post) Developing Hypotheses	-.769	1.613	.258	-1.292	-.246	-2.977	38	.005	-.477
Pair 8 (pre) vs. (post) Developing Methods	-.641	1.495	.239	-1.126	-.156	-2.677	38	.011	-.429
Pair 9 (pre) vs. (post) Analyzing Statistics	.179	1.554	.249	-.324	.683	.721	38	.475	-.116
Pair 10 (pre) vs. (post) Discussing Findings	-.154	1.368	.219	-.597	.289	-.703	38	.487	-.112

The majority of the data collection for this study occurred prior to the global COVID-19 pandemic. To determine if there exists a post-COVID effect on research comfort level (RQ2), a subset of data for classes in the three years prior to the onset of the rapid transition to online learning (2017 – 2019, courses = 4, n = 81) and the two years since the onset (2020 – 2021, courses = 5, n = 83) was selected. Analysis revealed no differences between pre- and post-COVID average research comfort levels for the beginning of the semester (t(147) = -.219, p = .414). However, students reported lower comfort levels for the end of the semester pre-COVID (M = 3.83, sd = .86, n = 43)

compared to post-COVID (M = 4.22, sd = .72, n = 32), (t(73) = -2.110, p = .019, Cohen's d = .804).

CONCLUSION

In general, overall self-efficacy toward research-related tasks of students enrolled in undergraduate research methods courses increased across sections over time regardless of teaching modality (Face-to-face, Online, or hybrid). For the Face-to-Face modality, comfort-level increased between beginning and end-of-semester for all ten research-related tasks, including analyzing statistics. For asynchronous Online sections of the course, comfort-level increased between beginning and end-of-semester for seven out of the ten research-related tasks. However, for hybrid sections of the course, comfort-level increased for only two of the research-related tasks (creating a literature search plan and choosing search tools). In the hybrid sections of the course, students reported a decreased comfort-level with analyzing statistics. No such decrease in comfort-level with analyzing statistics occurred in the asynchronous Online sections of the course.

According to Schroeder et al. (2007), "if students are placed in an environment in which they can actively connect the instruction to their interests and present understandings and have an opportunity to experience collaborative scientific inquiry under the guidance of an effective teacher, achievement will be accelerated" (p. 1452). Globally, engagement in research-related tasks appears to reduce overall anxiety towards research and promote sense of ability in conducting these tasks. Tashakkori and Teddlie (2003) posit that instructors teaching undergraduate research methods in the social and behavioral sciences should take a mixed-methods approach which considers the questions students seek to answer. Prompting students to engage in the tasks associated with analyzing claims and creating credible claims in a controlled classroom environment in such a way that increases self-efficacy should have positive effects on their post-education careers.

Sproken-Smith (2005) argued that a problem-based approach assists students in developing a range of transferable skills to the post-education workplace. Additionally, Bridges (2020) argued that new technology-based tools for data collection and analysis compel students to acquire those skills before they enter the workforce. According to Peterson (2021), asynchronous online research courses provide opportunities to create experiential learning for students, particularly for those who are working. Peterson (2021) argued that the end-of-course project that requires statistical analysis teaches higher-order thinking that is prized by companies and is a learning goal for accrediting agencies such as the AACSB. Brew (2003) argues that "for all students, no matter what their ability or study motivation, the pursuit of professionalism embodied in the quality conception of scholarship can be a useful foundation for whatever the student engages in when they graduate" (p. 16).

Although the current study had sufficiently high sample and subsample sizes for generalizability, the study was limited to a single instructor over the course of 19 years. Other instructors might approach the subject matter that increases or fails to increase students' self-efficacy in performing specific research tasks. Additionally, not all research methods courses available to undergraduate

majors may include the specific research tasks covered by this instructor. Indeed, some instructors at the same institution may not require students to collect and analyze quantitative data but rather may take a knowledge-based approach to the subject. Nevertheless, this instructor's approach allows for testing student comfort-level with perhaps the most anxiety-inducing course task for research methods: quantitative analysis of survey data.

By applying the same methodology across multiple sections of the same instructor's course, and across multiple teaching modalities by the same instructor, communication educators can apply similar approaches to increasing student self-efficacy in research-related tasks. Future studies could investigate whether self-efficacy translates into actual ability by testing task outcomes pre-learning and post-learning opportunities. It also might be interesting to investigate whether learning outcomes are increased when students are required to collect and analyze data as a task in the course through skills-based approaches as opposed to learning about the task through only knowledge-based approaches.

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