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Medical Laboratory Science Students at the University of Southern Mississippi Response to the COVID-19 Pandemic

Kaitlyn McGinnis
The University of Southern Mississippi

Medical Laboratory Science Students at the University of Southern Mississippi Response to the COVID-19 Pandemic

by

Kaitlyn McGinnis

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Approved by:

Cynthia Handley, Ph.D., Thesis Advisor,
School of Biological, Environmental and Earth Sciences

Jacob F. Shaefer, Ph.D., Director,
School of Biological, Environmental and Earth Sciences

Sabine Heinhorst, Ph.D., Dean
Honors College

ABSTRACT

The COVID-19 pandemic has changed educators' and students' perspectives on virtual teaching of the laboratory sciences. This study aims to determine the perceived effects of the COVID-19 pandemic on Medical Laboratory Science (MLS) students at the University of Southern Mississippi. This study will evaluate how the changes to the instruction of the MLS curriculum and overall student mental health affected their grades and retention of academic content during and post-pandemic. The goal is to determine students' perception of the effectiveness of virtual learning during the COVID-19 quarantine period, and whether it is a sustainable learning resource. Five students enrolled in the junior medical laboratory science curriculum during the COVID-19 quarantine period completed a questionnaire related to their mental health status before and after the quarantine period, grades, retention of academic content during and after the quarantine period, and whether they were able to create a productive work environment during the quarantine period. Most students experienced a perceived increase in anxiety and depression and an increase in poor mental health status. It was also indicated that two of the five survey participants were not able to create a productive work environment during the stay-at-home order. Furthermore, students noted an improvement in their grades and academic course retention levels when face-to-face classes resumed. This study implies that the disadvantages that coincide with virtual learning affected Medical Laboratory Science students' ability to successfully learn critical laboratory skills.

Keywords: Virtual learning, COVID-19, Laboratory education, Mental Health, Global pandemic shutdown

DEDICATION

I would like to dedicate my thesis to my parents. I cherish both your undying support and dedication toward my education and the betterment of myself.

ACKNOWLEDGMENTS

Firstly, I would like the express my deepest and sincerest gratitude toward my thesis advisor, Dr. Cynthia Handley. I would not have persevered without your patience and extensive knowledge of laboratory education. I would also like to acknowledge Thomas J. Lipscomb, Ph.D., and Mary Lux, Ph. D., for their dedication and advisement of this project. It is greatly appreciated.

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LIST OF ABBREVIATIONS

MLS	Medical Laboratory Science
USM	The University of Southern Mississippi
CLIA	Clinical Laboratory Improvement Amendments

CHAPTER I: Introduction

Background

The COVID-19 pandemic began with the SARS-CoV 2 virus outbreak in Wuhan, China. This pandemic caused global shutdowns among most public spaces, including colleges and grade schools. While public shutdowns in larger cities have happened during previous pandemics, like the 2009 H1N1 pandemic, the SARS-CoV 2 virus caused a global shutdown of all public areas that were deemed nonessential for daily life (Jhaveri, 2020). The panic from the COVID-19 pandemic is likely due to the unanticipated strain of coronavirus. Since the influenza virus is a yearly occurrence, and mutated strains often occur, most people are desensitized to the idea of becoming sick with the flu. However, the coronavirus has a higher transmission rate and a lower herd immunity rate. This issue caused politicians, under the advisement of health professionals, to decide to shut down nonessential public spaces, including universities, to decrease the spread of the coronavirus and prevent healthcare facilities from overcrowding. This lockdown resulted in the conversion of all university courses to the online or virtual format.

Educational Approaches

There are advantages and disadvantages to the virtual learning format adopted during the COVID-19 pandemic. The abrupt switch from in-person to online courses caused many teachers and students to reevaluate their teaching/learning methodologies. Most lectures and lab experiences during the COVID-19 quarantine period were formatted as pre-recorded lectures or detailed PowerPoint slides.

One advantage of the COVID-19 quarantine period regarding education is the time efficiency of online learning. When prerecorded lectures and PowerPoints are posted

online, students can access the lesson at any time and as many times as needed (Quiang et al., 2020). This can be beneficial for students who move at a slower pace than their peers or have other time-sensitive obligations. The University of South Australia studied the efficacy of virtual learning in a histology class during the COVID-19 pandemic. The students' evaluations of the course rated the effectiveness of Zoom lessons as 4.92/5 and the overall understanding of the material as 4.78/5. One of the positives of online learning noted by the students was the ability to self-pace and look back on previous content (Caruso, 2020).

Another advantage of the switch to virtual learning is the cost-effectiveness of online labs. Daily lab sessions are of great expense and time-consuming. A simulated lab is also risk-free when concerning student health since students are not in a physical environment with chemicals and biohazardous substances. It is implied in the journal article "Virtualization of Science Education: a Lesson From the COVID-19 Pandemic" that virtual labs are more effective for pre-requisite lab-based courses rather than professional/ specialized lab courses, such as the courses included in the MLS curriculum. Furthermore, virtual labs are proven to be most useful when used synergistically with hands-on learning (Ray & Srivastava, 2020).

While some educators find virtual learning to be beneficial, that is not always the case for courses that require a visual or kinesthetic approach. Learning in an environment that is not face-to-face results in less interaction among students to build support and confidence in the course material. This can lead to decreased student engagement (Quiang et al., 2020). Communication with classmates and kinesthetic learning of the

course material is important for laboratory-based courses. Collaboration allows students to navigate the different perspectives and possible errors of an experiment.

In the journal article concerning laboratory-based immunology education, it was determined that proficiency in practical laboratory skills is critical for success in that field of work (Wilkinson et al., 2021). Education techniques such as videos, simulations, and data sets are recommended by the author as adequate methodologies for the theoretical understanding of laboratory-based subjects. However, it is agreed that these methodologies do not address the challenges laboratorians encounter such as errors created by human involvement. The author concluded that successful online laboratory course should be supplemented with face-to-face instructional lessons (Wilkinson et al., 2021).

In addition, it is necessary to address the socioeconomic gap and its effect when considering virtual courses for higher education students. This concern with virtual learning is harder to resolve, especially when online courses are required. Some students working in challenging learning environments may be at a disadvantage over those with stable home lives. Most students need a school environment to effectively study with no distractions. For example, parents are more likely to prioritize domestic tasks over educational prospects. Students with children were required to carry the weight of homeschooling and childcare while studying and preparing for online classes during the COVID-19 quarantine period. Due to the limitations of home, work, and childcare responsibilities, parents were put at a disadvantage when completing the online courses necessary for their degree plan, especially if the family lacked adequate technology (Sohrabi et al., 2021).

Mental Health

An article from the *Journal of Chemical Education* reported that teachers noticed students lost engagement in their laboratory studies due to the lack of physical engagement with the course materials. Virtual learning caused anxiety among students because the virtual lab experience may affect their future job performance (Qiang et al., 2020).

Due to the stay-at-home order, university students were isolated from their friends and classmates. Lack of support from peers can cause students to do poorly in their educational studies. In a study from the *Family Process Journal*, it was determined that self-isolated individuals during COVID-19 had a higher rate of loneliness and poor psychological health (Szkody et al., 2020). Their study was based on the Stress-Buffering Hypothesis which stated that social support can counteract normal day-to-day stress. Students had higher rates of anxiety and depression the longer they went without the social support of their peers (Szkody et al., 2020).

Medical Laboratory Science Curriculum

Medical laboratory scientists are critical to the diagnosis and analysis of disease. A medical laboratory scientist's education consists of a carefully curated curriculum. The purpose of the curriculum is to inform future laboratory workers of the information needed to conduct the quality control and monitoring of diagnostic tests (including waived, moderate, and high complexity testing), patient progression, disease surveillance, and more (Ibeh et al., 2020). The Clinical Laboratory Improvement Amendments (CLIA) indicate stricter personnel education requirements for higher difficulty levels of testing.

For example, a test that requires interpretation and judgment of the preanalytical, analytical, and post-analytical processes of a test will be deemed high complexity. This test will require test personnel to have special knowledge and skills of the material being tested (CLIA Categorizations, 2020). The curriculum of the Medical Laboratory Science (MLS) program at the University of Southern Mississippi (USM) prepares students for the ability to process, perform, and interpret results at a high complexity level. Some examples of the required MLS subjects include bacteriology, immunohematology, hematology, clinical chemistry, and immunology. The curriculum consists of a junior year and a senior year. Students begin in their junior year with two semesters of on-campus 300-level courses. These courses are the introductory courses for the 400-level courses. Students must make a C or better in junior-level MLS courses to be admitted into the senior year. Upon admission, the student will begin with phase I of two phases included in the senior year. Phase I consist of two semesters of on-campus 400-level courses. Phase II includes one semester of clinical rotations with hands-on laboratory experience at a hospital-based clinical affiliate site. When the shutdown of all nonessential public spaces was mandated, The University of Southern Mississippi switched to 100% online courses after a two-week spring break vacation on the 30th of March 2020 until the end of the Spring 2020 semester. During this period, all students conducted their learning in their home environment. Consequently, MLS students lost two months of in-person laboratory training.

Purpose

The COVID-19 pandemic has changed educators' and students' perceptions of virtual learning in the laboratory sciences. This research focused on how the COVID-19

pandemic quarantine period, March 2020-May 2020, affected students in the Medical Laboratory Science (MLS) program at the University of Southern Mississippi. This study evaluated how the changes to the MLS curriculum and overall student mental health affected their retention of academic content during, and after, the pandemic quarantine period.

The overarching purpose of the research was to determine medical laboratory students' perception of the effectiveness of the virtual learning curriculum adapted during the COVID-19 quarantine period. Evaluation of students' attitudes and retention of the course material may show insight into how the absence of the typical classroom setting, with the tangible support of teachers and peers, affected the students' ability to succeed in the class. A student's success was determined by the evaluation of their retention of class material during that time, as well as whether their grades were affected by their ability to retain course content for future courses. This study may provide useful information for the effective course development of virtual classes should future challenges in the delivery of educational content occur.

CHAPTER II: Method

Participants

Participants for this study included students in junior-level medical laboratory science classes at the University of Southern Mississippi during the Spring 2020 semester. Specifically, the questionnaire was sent to students who were enrolled in Fundamentals of Hematology (MLS 306 & MLS 306L) and Clinical Bacteriology I (MLS 302 & MLS 302L). The students selected continued into the Fall 2020 MLS curriculum, in which the classes were held in person at a limited capacity. This specific criterion for the students receiving the questionnaire was established to properly illustrate the student's perceived academic progression while navigating the COVID-19 pandemic.

Procedure

Before beginning data collection, the Institutional Review Board (IRB) approval committee of the University of Southern Mississippi approved the questionnaire shown in Appendix A below. Using Qualtrics management software, thirteen students that met the participant criteria of the study received an eleven-item questionnaire formatted on a five-point Likert-like scale. Participation in the study was voluntary and anonymous. In the questionnaire, participants scored their anxiety, depression, and overall mental health during and after the pandemic quarantine from poor to good. The pandemic quarantine was defined as the global shutdown period from March 2020 to May 2020. Another set of five-point Likert-like scale questions followed asking how the participants felt the quarantine period impacted their grades and retention of the course content during and after the pandemic. This was scaled on a range from extremely negative to extremely positive. Finally, the participant was asked, with a five-point Likert scale ranging from

disagree to agree, whether they were able to create a quiet, productive work environment during the quarantine period. The link to Qualtrics was emailed to the participants on November 8, 2021, and again on November 10, 2021, using the participant's designated school email address. The participants then completed and submitted the questionnaire during their own time. Data collection ended on November 12, 2021. There was no incentive involved in taking this survey

CHAPTER III: Results

The questionnaire was sent to thirteen qualifying MLS students from the University of Southern Mississippi. Five students completed the questionnaire after one week, giving the questionnaire a 38% response rate.

Mental Health

In the first set of questions, participants were asked to scale their mental health quality before and after the pandemic quarantine on a range from poor to good. Common mental health conditions and the participant's overall mental health were presented to the participant to consider and scale. To quantitate the data, numbers were assigned to each statement: 1 = Good, 2 = Somewhat Good, 3 = neutral, 4 = Somewhat Poor, 5 = Poor. Poor was reassigned as the highest number (5) because negative mental health has a high impact on a person's well-being. As seen in Figure 1, the data shows the average participants' anxiety level at a 3.8/5 pre-pandemic quarantine and 4.6/5 post-pandemic quarantine. Using the equation labeled figure 2, there was a 21% calculated increase in reported student anxiety throughout the pandemic quarantine period. Participants rated their depression lower on the scale at a level of 2/5 pre-pandemic quarantine and 3.2/5 post-pandemic quarantine. However, the level of depression had a higher calculated percent increase of 60%. To summarize the overall perceived effect the pandemic had on MLS students, they scaled their overall mental health status as 1.6/5 for the pre-pandemic quarantine period and 3.6/5 for the post-pandemic quarantine period. This indicates a 125% increase in poor mental health status among the participants.

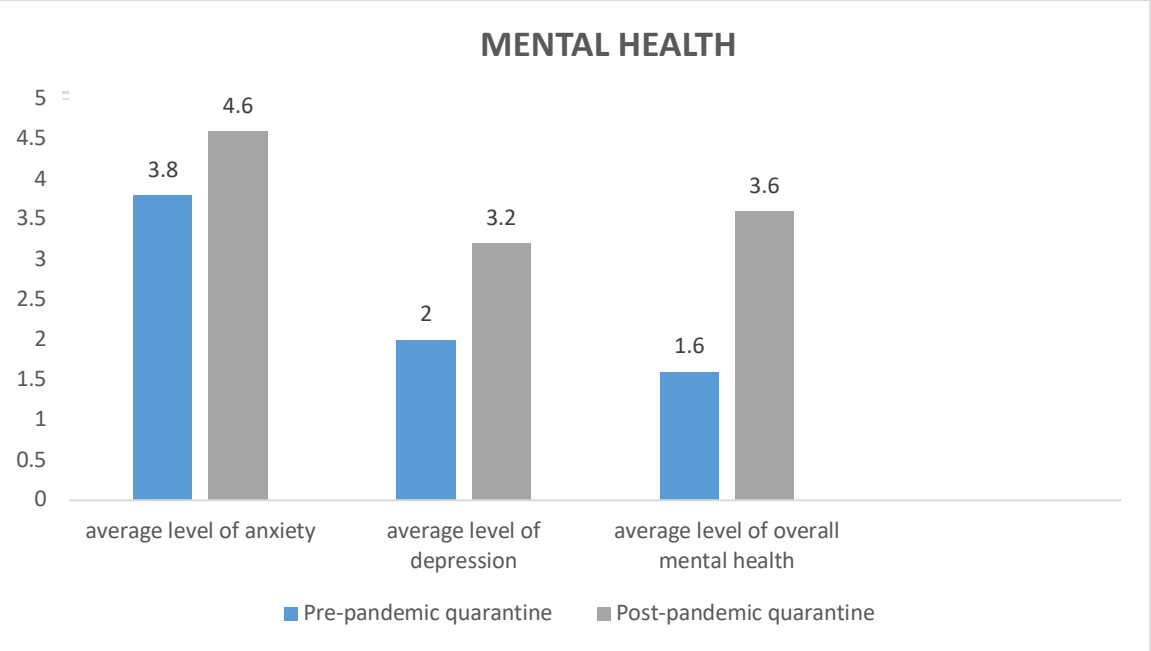

Figure 1: Change in Mental Health Status

$$Percent\ increase = \frac{final\ value - initial\ value}{initial\ value} x\ 100$$

Figure 2: Percent Increase Equation

Grades and Retention Levels

In the second block of the questionnaire, participants were asked to score their experience involving the impact of their grades and retention of the course content presented during the quarantine period during and after the pandemic quarantine on a range from extremely negative to extremely positive, neutral meaning no change at all. Firstly, the students were asked to assess whether they believed the change to the virtual learning format impacted their grades in their courses. Three out of five MLS students scaled the impact virtual learning format presented during the quarantine period as extremely

negative. Furthermore, one out of five MLS students had a negative experience with the new learning format, and another student considered there to be no change to their learning experience. The perceived impact on students' grades improved in the courses presented in the face-to-face format after the quarantine period with only one student rating their academic progress as extremely negative, two students as negative, and the last two ratings as neutral.

Students were also asked to assess their experience with retention of the course content presented during the COVID-19 quarantine period. This was asked to observe if students saw a difference in the ability to recall information for the courses with online instruction, which was the learning format presented during the at-home quarantine period, versus the courses with face-to-face learning format seen in the courses after the quarantine period. During the pandemic quarantine period, three of the five participants stated they had a somewhat negative experience with their retention of the course content presented in the online format. One of the participants considered the impact to be extremely negative and another participant saw no change at all. In classes after the pandemic quarantine period, two of the participants stated their experience with retention of the face-to-face course content was somewhat positive, while another two of the participants stated the post-pandemic environment had a somewhat negative impact on their retention of course content. One participant saw no change in their academic retention post-pandemic quarantine.

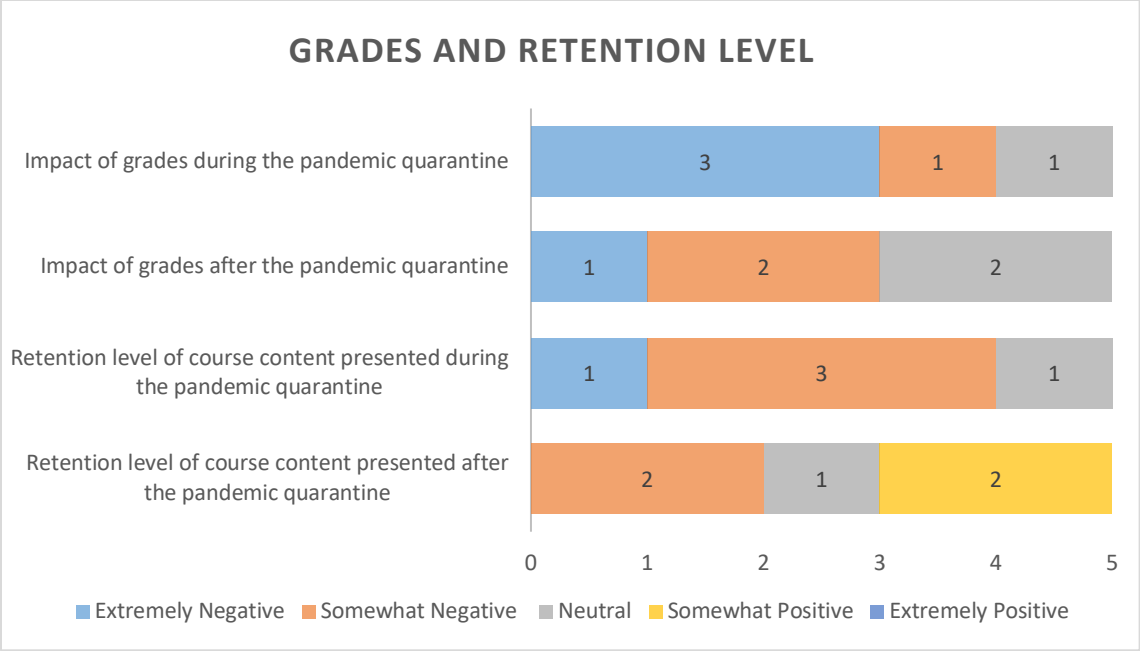

Figure 3: Change in Grades and Retention Levels

Productivity

The last block of the questionnaire contained one statement that ranges from agree to disagree: "I was able to create a quiet, productive work environment during the quarantine period of the COVID-19 pandemic." Participants were told to scale their experience during the said period. This was asked to determine whether the environment the student studied in was a factor in their mental health, grades, and/ or academic retention. Forty percent of students disagreed with the statement, while forty percent somewhat agreed with the statement. Twenty percent of the participants stated they were neutral, meaning their study environment had no impact on them.

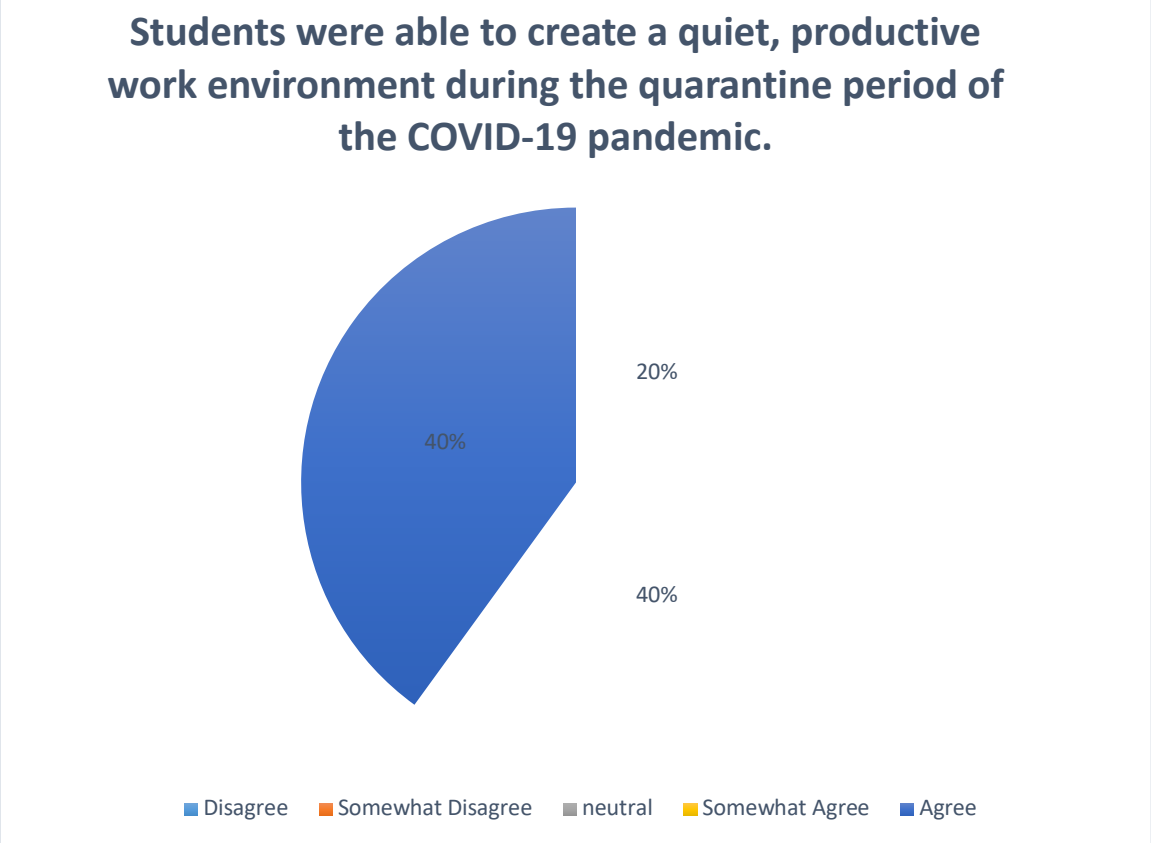

Figure 4: Productivity of Student's Work Environment

CHAPTER IV: Discussion

Discussion

The purpose of this study was to evaluate how the changes in the delivery of the MLS curriculum during and after the COVID-19 pandemic quarantine period affected the perceived overall student mental health, grades, and retention of the course content. In finding correlations between these factors, educators can use the information provided to consider the possibility of changing their approach to virtual learning for laboratory education. From personal experience, the COVID-19 pandemic quarantine's impact on my mental health and my study environment was a hindrance to my ability to successfully retain and apply the course information given.

Anxiety is common among all college students, not only MLS students. The curriculum is likely to induce such a high anxiety rate without the assistance of a global pandemic. Students who participated in the quarantine semester found that their anxiety increased an average of two points on a ten-point scale after the pandemic. The perceived increase the students saw in their anxiety could be from many factors. The change in learning formats, lifestyle, and physical health are all possible factors that are likely to induce anxiety.

It is also important to note the substantial increase in the depression rate. While students did not grade their depression levels as high as anxiety levels, most MLS students found that their depression increased by 60%. The social isolation caused by the pandemic likely contributed to changes in mental status. Medical laboratory scientists typically have an introverted personality type. Rasmussen University considers a medical laboratory scientist as being the number one job for introverts (Flavin, 2019). However,

laboratory students depend on consultation with other peers to solidify their understanding of the material and confidence in completing the task at hand. One can speculate that the overall increase in a student's poor mental health lowers a student's drive to learn and do well in a person's educational studies

Grades and retention of the course content are both considered when determining the perceived effect of the virtual learning format implemented during the quarantine period. Each course in the MLS curriculum at USM includes information that builds from course to course. If a student does not understand a lower level/introductory course, he/she may not do well in the upper-level courses. Three out of five students said their grades were negatively impacted during the pandemic quarantine, and four out of five students said their retention of the course information given during that period was negatively impacted. Taking into consideration that students felt there was more of a negative impact on information retention rather than grades, one can speculate that the virtual learning format may have induced a lack of confidence in students. This speculation can be validated by the increase in the student's perceived retention of the course content shown after the COVID-19 pandemic quarantine period when the face-to-face classes resumed.

Conclusion

The stressors associated with the COVID-19 quarantine period, including mental health status, caused negative impacts on student grades and retention of course content. This specific study is meaningful due to the rigorous program and the importance of the medical laboratory scientist's role in the COVID-19 pandemic. In this study, most students seemed to struggle with the sudden shift in teaching methodologies. Quality

education is critical for these essential workers as they will be the ones to help manage any future pandemics. Now is the time for trial and error of new teaching methods to help these students be successful in their future careers.

The results of this study may be skewed because of the small participant population. Descriptive statistic were not helpful in this study due to the small sample size. Further research on the perceptions of graduates that participated in a medical laboratory science program curriculum before and after the COVID-19 pandemic quarantine period could be done to validate the findings from this participant population. A thorough evaluation of how a student's ability to create a productive work environment would benefit from questions regarding socioeconomic status.

Overall, the lack of a large participant population was a hindrance to this study. One way to improve participation would be to contact participants through personal email addresses rather than school-assigned emailed addresses Many of the students who were asked to participate were in the second stage of the MLS curriculum at an off-campus clinical site rotation. It was noted that these students in the off-campus phase were less likely to respond to their school-designated email addresses.

APPENDIX A: QUALTRIC QUESTIONNAIRE

COVID-19 Pandemic Effects on Medical Laboratory Science Students at the University of Southern Mississippi

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Start of Block: Consent page

Consent COVID-19 Pandemic Effects on Medical Laboratory Science Students at the University of Southern Mississippi

Principal Investigator: Kaitlyn McGinnis

Research Advisor: Cynthia Handley

This questionnaire will be used to study how the switch to virtual learning halfway through the Spring 2020 semester may have affected your ability to succeed in future Medical Laboratory Science classes. The goal is to determine whether virtual learning will be an effective learning option for laboratory-based classes during future pandemics.

There is a likelihood this survey can bring up emotions connected to the national COVID-19 quarantine period. If you are experiencing negative emotions associated with this period and the questions listed please contact USM counseling services for free and confidential mental health services at this number: 601-266-4829. The on-campus Hattiesburg counseling center is located on 103 Ray Guy Way Bond Hall South.

All information gathered from this questionnaire is anonymous. No identification factors are presented in the survey. When results from the questionnaire are completed, it will be stored online in a password protected folder for three years until it is deleted. If you have any questions please contact Kaitlyn McGinnis or Cynthia Handley via email: kaitlyn.mcginnis@usm.edu cynthia.handley@usm.edu

Consent to participate in research:

I understand that participation in this project is completely voluntary, and I may withdraw at any time without penalty, prejudice, or loss of benefits. Unless described above, all personal information will be kept strictly confidential, including my name and other identifying information. All procedures to be followed and their purposes were explained to me. Information was given about all benefits, risks, inconveniences, or discomforts that might be expected. Any new information that develops during the project will be provided to me if that information may affect my willingness to continue participation in the project.

By clicking the box below, I give my consent to participate in this research project.

- ○ Yes, I agree to participate. (1)
- ○ No, I do not wish to participate. (2)

End of Block: Consent page

Start of Block: Block 1

The "COVID-19 pandemic quarantine period" refers to the period of time during the months of March 2020- May 2020 that caused many universities to convert to virtual learning platforms.

Question 1: Scale your mental health quality during said time period from poor to good.

	Poor (1)	Somewhat Poor (2)	Neutral (3)	Somewhat Good (4)	Good (5)	Would rather not say (6)
Anxiety level BEFORE the COVID-19 pandemic quarantine period (1)	○	○	○	○	○	○
Anxiety level AFTER the COVID-19 pandemic quarantine period (2)	○	○	○	○	○	○
Depression level BEFORE the COVID-19 pandemic quarantine period (3)	○	○	○	○	○	○
Depression level AFTER the COVID-19 pandemic quarantine period (4)	○	○	○	○	○	○
Overall mental health BEFORE the COVID-19 pandemic quarantine period (5)	○	○	○	○	○	○
Overall mental health AFTER the COVID-19 pandemic quarantine period (6)	○	○	○	○	○	○

Question 2: Scale your experience during said time periods from Negative to Positive.

	Extremely negative (1)	Somewhat negative (2)	Neutral (3)	Somewhat positive (4)	Extremely positive (5)	Would rather not say (6)
How did the switch to virtual learning DURING the COVID-19 quarantine period impact your grades? (1)	○	○	○	○	○	○
How did the switch to virtual learning AFTER the COVID-19 quarantine period impact your grades? (2)	○	○	○	○	○	○
How was your retention level of the presented course content DURING the COVID-19 quarantine period impacted? (3)	○	○	○	○	○	○
How was your retention level of the presented course content AFTER the COVID-19 quarantine period impacted? (4)	○	○	○	○	○	○

Question 3 Scale your experience during the said period from Disagree to Agree

	Disagree (1)	Somewhat Disagree (2)	Neutral (3)	Somewhat Agree (4)	Agree (5)	Would rather not say (6)
I was able to create a quiet, productive work environment during the quarantine period of the COVID-19 pandemic (1)	○	○	○	○	○	○

End of Block: Block 1

APPENDIX B: IRB APPROVAL LETTER

Office *of*
Research Integrity

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

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NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident submission on InfoEd IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.

PROTOCOL NUMBER:	21-003
PROJECT TITLE:	COVID-19 Pandemic Effects on Medical Laboratory Science Students at the University of Southern Mississippi
SCHOOL/PROGRAM	Medical Laboratory Sciences
RESEARCHERS:	PI: Kaitlyn McGinnis Investigators: McGinnis, Kaitlyn~Handley, Cynthia~
IRB COMMITTEE ACTION:	Approved
CATEGORY:	Expedited Category
PERIOD OF APPROVAL:	05-Nov-2021 to 04-Nov-2022

Donald Sacco, Ph.D.
Institutional Review Board Chairperson

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