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THE EFFECTIVENESS OF GOOGLE CLASSROOM IN THE SELF-CONTAINED CHEMISTRY CLASSROOM

by

Steven J. Gross

A Thesis

Submitted to the
Department of Interdisciplinary and Inclusive Education
College of Education
In partial fulfillment of the requirement
For the degree of
Master of Arts in Special Education
at
Rowan University
May 18, 2019

Thesis Advisor: S. Jay Kuder, Ed.D.

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Dedication

I would like to dedicate this manuscript to my adviser, Sydney Jay Kuder

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Acknowledgements

I would like to express my appreciation to Professor Sydney Jay Kuder for his guidance and help throughout this research. The skills and knowledge that I have gained are things that I will take with me into my next professional endeavor. I look forward to whatever challenges that come my way knowing that I am prepared to take them on.

I would like to thank my family for their unwavering love and support through this endeavor.

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Abstract

Steven Gross
THE EFFECTIVENESS OF GOOGLE CLASSROOM IN THE SELF-CONTAINED CHEMISTRY CLASSROOM
2018-2019
Sydney Jay Kuder, Ed.D.
Master of Arts in Special Education

The purpose of this exploratory investigation was to ascertain the effectiveness of Google Classroom in the self-contained Chemistry classroom in terms of student turning in of assignments, student performance on summative assessment, student satisfaction with the use of Google Classroom, student contribution to class discussion in terms of frequency and quality, and the student acceptance of Google Classroom as a system of technology. Results suggest increased growth on summative assessments, turning in of assignments, and less regression in turning in of assignments with the implementation and use of Google Classroom. Results also suggest that the student population performs better through face to face discussions, that students overall accept Google Classroom as a system of technology, and that students prefer to use paper for math-based assignments. Implications for the use of Google Classroom in the self-contained Chemistry classroom are discussed.

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Chapter 1

Introduction

In recent years, there have been drastic changes in the classroom that affect the delivery of instruction and how students are being taught, their classroom experience, and how they learn. For example, most American educators have made the switch from writing with chalk on a chalkboard to writing with dry-erase marker on a dry-erase board, or by writing using a touch screen on a SmartBoard. Furthermore, in the 2010s, many school districts introduced a one-to-one technology initiative such that all students have access to a device such as a chromebook, laptop, iPad, etc. Some educators have gone fully digital and paperless, moving toward a greener classroom as well as preparing students for the technological advances of the future. Conversely, some educators have technology-free classrooms and all student assignments are carried out on paper. Most educators at this point use a balance between technology use and paper use when it comes to the medium in which they educate their students. Recently, Learning Management Systems (LMS) such as BlackBoard, Canvas, Google Classroom, and Moodle have become increasingly popular at the middle school, high school, and higher education levels.

Google Classroom allows educators to post and collect assignments, administer and grade tests and quizzes, post curricular materials such as slide presentations and templates for student work, allow for discussion to ensue among students, and make announcements to their class.

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Statement of the Problem

The general consensus among educators across the world is that these LMS act as a classroom facilitator but are unable to replace the role of the teacher (Abid Azhar, Iqbal, 2018). The human aspect of teaching is not something that a machine is able to replace or rival at this point in time, however the machine is something that can be used to enhance and supplement the role of the teacher. The implementation of a LMS will not intrinsically lead to better student performance (Abid Azhar, Iqbal, 2018). However, that is not to say that there are not benefits to implementing these systems. In the Special Education setting, a problem that many teachers report is that students often lack organizational skills, evidenced by losing assignments, forgetting to write names on assignments, having illegible handwriting, missing deadlines, missing work due to absenteeism, and forgetting to turn in work that has actually been completed.

Students who have a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) typically have difficulty maintaining their attention span while completing school assignments. According to the National Institutes of Health (NIH) ADHD symptoms are characterized as: overlooking or missing details, making careless mistakes in schoolwork; failing to not follow through on instructions, failing to finish schoolwork, chores, or duties in the workplace, or start tasks but quickly lose focus and get easily sidetracked; and having problems organizing tasks and activities, such as doing tasks in sequence, keeping materials and belongings in order, keeping work organized, managing time, and meeting deadlines (NIH, 2016). In my experience, the grades of students that have this disorder often do not reflect their capability and actual learning because of all of the organizational difficulties they face in the classroom. Similarly, I have found that

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students may have the intention and drive to work on an assignment, have carved out time in their busy schedule to accomplish the task, but have lost the assignment or associated curricular materials altogether and are unable to complete the task on time or at all depending on teacher lateness policy.

Based on these needs, it is important for teachers of students with exceptional learning needs to understand the individual challenges faced by each student and differentiate their expectations and the availability of resources and the availability of teacher contact time outside of the typical school day for individual conferencing to help students work on these skills. Students need to be given an individualized appropriate challenge in terms of how much responsibility should be placed on them when it comes to organizing their curricular materials, seeking extra help vs being mandated to come for extra help, and being able to hand in late assignments.

Students with exceptional learning needs are helped by having this additional framework because it reduces organizational stress. Having a static place to reach all of their necessary resources and save their work greatly facilitates their learning process. In science classes in particular, there are many data sheets, tables, procedures, templates, and reports that students need to access on a daily basis. With the click of a few buttons, the teacher essentially creates a highly organized digital binder for each student that is impossible to misplace or have become disorganized.

Prior research has shown that LMS systems such as Google classroom can improve students' ability to access curricular materials and provide a built-in structure for students to follow in terms of completing and turning in assignments (Ventayen et. al, 2018). In addition to the aforementioned, educators have also reported that the use of

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learning management systems result in increased engagement in the learning especially by providing a forum for students to express their ideas and communicate with one another (Ventayen et. al, 2018).

Purpose of the Study

The purpose of this study was to investigate the effectiveness of Google classroom as an instructional facilitator for students with exceptional learning needs in a self-contained high school chemistry classroom. The study examined specific areas where Google Classroom may improve student performance including (a) frequency of handing in assignments altogether, (b) frequency of handing in assignments on time, (c) scores on summative assessments, (d) student perception of the use of Google Classroom as an LMS, (e) frequency of student contribution to class discussion, (f) quality of student contribution to class discussion, and (g) amount of student contribution to class discussion within individual occurrence. The research questions to be examined are:

1. Will the use of Google Classroom increase the frequency of assignments being turned in and/or being turned in on time in a resource room?
2. Will student performance on summative assessments improve if administered through Google Classroom?
3. Will students be satisfied with the use of Google Classroom? What will they identify as benefits and limitations of the program?
4. Will Google Classroom increase the frequency of student contribution to class discussion?
5. Will Google Classroom increase the quality of student contribution to class discussion?

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6. Will Google classroom increase the amount of words student contribute to class discussion?

Significance of the Study

The knowledge gained from this study will allow for the improvement of the learning experience of students with exceptional learning needs in science classrooms and the delivery of instruction by their educators. Previously, it had been impractical for an educator to maintain the tangible paper organization of their many students, but with the advent of LMS, disorganization will become a thing of the past. Grading, lesson planning, collecting data on students for progress monitoring, and moving to a greener classroom will be possible thanks to LMS.

Key Terms

For the purpose of this study, the following terms will be defined as follows:

1. **LMS: Learning Management System:** software application for the administration, documentation, tracking, reporting and delivery of educational courses or training programs.
2. **Google Classroom:** free web service developed by Google for schools that aim to simplify creating, distributing and grading assignments in a paperless way. The primary purpose is to streamline the process of sharing files between teachers and students.

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Chapter 2

Literature Review

Learning Management Systems (LMS) are important and effective for creation of educational digital platforms for educational institutions that allow for opportunities for networked forms of educational communication, improve the quality of the progress of youth as well as knowledge transfer. LMS continues to evolve, with new functionalities added each school year. The use of LMS is very widespread and is used in many institutions of learning. The use of LMS in the classroom is essential for preparing students for a digital future. Technology in the educational process is a new way to form an environment of modern education. Gorshenin (2018) claims that LMS can help lead education toward a digital economy. LMS give the teacher the opportunity to demonstrate various aspects of the course interactively and control the educational delivery, including different ways to assess students. These are important elements of the modern educational process because the digital economy is omnipresent, and students need to develop the competencies to interact effectively in this new era. The implementation of these programs is simply required if we are to prepare our students to be productive citizens of the future. This increased use of technology allows for students to come together for the creation of an information environment. Teachers are able to seamlessly collect data on student progress and organization is facilitated greatly because the teacher can in effect lay out all of the course materials and assignments for the students in a cohesive manner (Gorshenin, 2018).

Despite the implementation of College and Career Readiness initiatives as well as the Common Core State Standards, the fact remains that students with exceptional

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learning needs have lower employment rates than their peers without disabilities (The National Collaborative on Workforce & Disability for Youth, 2014). Additionally, students with exceptional learning needs tend to be unemployed more often, and when they are employed, they earn lower wages (Sanford et al., 2011). Additionally, these students have lower retention rates and lower degree completion rates (Horn et al., 1999; Murray et al., 2000), and take longer to complete degrees (Wessel et al., 2009). In light of the above, it becomes apparent that current transition services for individuals with exceptional learning needs are not keeping pace with the demands of the knowledge economy in the 21st century, also known as 21st Century Skills. Given the ubiquitous nature of technology in our society entrants into the workforce must be computer-literate, and this trend will only intensify as time goes on. Among adolescents with disabilities, IT literacy has been shown to be an effective method of instructional delivery of college and career readiness, 21st century skills, and transition content (Izzo et al., 2010). Functional literacy in the 21st Century is especially important given that the majority of the reading that students do now is online. This demands additional strategies to navigate the Internet, comprehend higher level text, and discern between different types of online tools and media, and evaluate the credibility of information. According to a study done by Lombardi in 2017, students with exposure to content instruction with the use of an LMS have been shown to perform better when it comes to making gains in IT literacy skills. They designed a study utilizing an online learning platform called Envision IT which incorporates IT literacy and Common Core State Standards in English Language Arts. The study involved 108 students with exceptional learning needs. The test group received instruction which was administered in conjunction with this online

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platform, and the control group received services that were administered in the traditional paper method. Students in the experimental group made significantly larger growth in information technology literacy than those that were in the control group and showed greater gains in transition skills (Lombardi, 2017).

Studies of the use of LMS Systems with Students with Exceptional Learning Needs

Several studies have examined the use of LMS systems in classrooms that included students with exceptional learning needs. For example, Fernandez-Lopez et al (2017) examined the effectiveness of an electronic educational programming platform - Picca for use with teachers in classrooms of students with exceptional learning needs. Teachers were able to make customizations to the programming offered based on individual student need. The teachers then instructed the students on how to use the platform and then had the students use the programming in class. The teachers collected data on the student performance in a variety of areas including language, math, environmental awareness, autonomy, and social skills. The researchers were able to show with confidence that students that received exposure to this adjunctive educational technology had higher scores when compared to themselves on the post-test in all of the aforementioned areas. These results were found to be statistically significant for all student groups regardless of gender or nature of disability. Therefore, all students that received the adjunctive instruction via the Picca platform showed greater growth in the aforementioned areas (Fernandez-Lopez, 2013).

This research is promising because it shows that teachers can implement electronic platforms to supplement student learning for students with exceptional learning

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needs which will lead to improvements in student growth when it comes to content and skill-based knowledge regardless of gender of student groups or nature of disability.

(Billingsley et al (2009) analyzed the effect of using a blended learning environment with the use of OdysseyWare for student progress in a self-contained high school Math class. The OdysseyWare learning platform is a multimedia enhanced platform for delivery of curriculum that includes diagnostic features, individualized, self-paced instruction, and teacher management utilities. The researchers compared the effectiveness of three different modalities of instruction - direct instruction alone, direct instruction combined with OdysseyWare learning platform, and OdysseyWare learning platform alone. Results showed that improved performance varied by program for individual student. Seven out of the ten students performed better when provided direct instruction combined with the OdysseyWare learning platform. Two of the ten students performed better when provided direct instruction alone. One of the ten students performed better when provided instruction through the OdysseyWare program alone. While any of the three methods will not result in universal positive learning outcomes, the greatest number of students improved when instructed with a combination of both direct instruction and the online learning platform. This research is important because it holds that the greatest number of students will benefit from a mixture of teacher guided web-based instruction along with traditional direct instruction.

Student Perceptions on Blended Acceptance Model

In addition to evaluating the effectiveness of learning management systems, it is important to know student attitudes toward the technology. Legris et al. (2003) examined a system that is used to determine perceptions of technology by human beings and

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whether or not a technology system has practical value in a variety of settings such as schools or businesses called the Technology Acceptance Model (TAM). The TAM is the mainstay when it comes to analyzing perceptions of technology systems as it has been shown to be 40% successful at predicting a system's use. Originally, 39 factors were described that can influence user satisfaction. These 39 factors can be grouped into three categories or variables: uncontrollable (e.g. task technology and organizational timeframe), partially controllable (e.g. psychological climate and systems development backlog, fully controllable (e.g. end-user computing (EUC) training, rank of EUC executive, and EUC policies). In essence, TAM is a way to measure these factors mathematically to see whether or not users will accept or reject a technology system. Although there are 39 factors outlined, there has not been a single study that analyzes all of them. A questionnaire is designed and administered to find trends in perceptions of the technology programming and how the individual trends correlate to each other. TAM has been used in the past to predict whether individuals would accept or reject email, voicemail, and Microsoft Windows operating system. In the study below, TAM was used to predict the usability of a learning management systems.

Tselios et al (2011) used an extended Technology Acceptance Model (TAM) to investigate university students' attitudes toward blended learning facilitated by the Moodle program, which rivals Google Classroom as one of the leading free learning management systems. The students received instruction in the blended learning platform such that each week a different mini-project was presented to each student and related theory was presented in a three-hour lecture meeting. Students also attended a 2-hour lab session where the content and task were accessed through the Moodle format and the

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assignment was to be submitted through Moodle. The students had access to Moodle resources at all times inside and outside of the classroom. Using a questionnaire based on the original TAM constructs, the researchers were able to test whether: the students' attitude toward use of the LMS would have a positive effect on behavioral intervention, perceived usefulness would have a positive effect on behavioral intervention, perceived ease of use would have a positive effect on attitude toward use, perceived usefulness would have a positive effect on attitude toward use, and if perceived ease of use would have an effect on perceived usefulness. They compiled and analyzed the data and found that both ease of use and perceived usefulness have a positive effect on attitude toward use.

Summary

The first two research studies have shown that blended learning through the use of technology platforms can have an impact on the development of fluency in a variety of academic areas for students with exceptional learning needs. While all students have different needs and individualization is one of the major tenets of special education, the greatest number of students showed growth when instructed through a combination of using a digital learning platform and receiving direct instruction from the classroom teacher.

The third research study explains the Technology Acceptance Model (TAM) and how it can be used to predict the practicality, usability, and perceptions of any form of technology. This method has been used extensively in the corporate setting for research and is gaining more popularity in the education setting. Therefore, TAM can be used to

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analyze and predict the practicality of learning management systems, such as Google Classroom.

The fourth research study used TAM to measure the practicality of the Moodle learning management system at a tertiary institution. Researchers found that both ease of use and perceived usefulness had a positive effect on attitude toward use, indicating that students found the program to be user-friendly and/or helpful which led to positive attitude toward use of the program.

While the first two studies showed positive outlooks for blending learning for students with exceptional learning needs, and have been very informative, they did not involve the specificity of testing a learning management system.

The fourth study used TAM and showed positive outlooks for using learning management systems with students. However, the research was done at a tertiary institution. Further research is necessary; therefore, the proposed study is novel as it will test the effect and practicality of using Google Classroom as a means of blended learning for students with exceptional learning needs in the secondary Chemistry classroom.

Watson (2018) argues that LMSs have monumental importance as we progress through the Information Age paradigm of education. LMSs are so important, yet very little research has been done when it comes to these systems. More studies are needed on the effectiveness of the LMS systems and these studies should examine much more closely what features are offered, which additional features are needed. More information must be gathered on student, teacher, parents, and other stakeholder perceptions on these systems as well as perceptions specific to individual features.

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Further research will allow for technology to be maximized to better meet the needs of the students and help guide decisions and future applications of the technology.

The aspects of these studies that relate to the study that I will have conducted and completed are that I can learn from previous research methods of implementation and incorporation the technology platforms in order to test for the enhancement of student learning. The methods sections of the first four studies mentioned will be highly instrumental and will serve as exemplars to be adapted toward my study. I will be able to adapt the TAM to my study to gain insights into student perceptions and acceptance of Google Classroom. Finally, the fifth study mentioned emphasis that there is such a dearth of research on LMS impacts, let alone in the secondary education classroom of students with exceptional learning needs. I will be able to shed important light on a topic that needs to be researched for the sake of the students as they approach their post-secondary lives in the so-called Information Age.

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Chapter 3

Methodology

Setting

School. This study took place in a public school in a district in Upper Bergen County, New Jersey. The school is the high school, one of 10 total schools in the district including one preschool, six elementary schools, and two middle schools. The district serves students from preschool through twelfth grade. The population of the student body is approaching 1800. The district is technologically advanced and there is a 1:1 initiative where all students starting in the 6th grade and higher have a Chromebook. According to the New Jersey Performance Report, the school consisted of approximately 1732 students in 2016, the most recent year a report was given. In 2016, approximately 11% of the student population had disabilities. The school only has a somewhat diverse student population in comparison to other districts in New Jersey. In 2016, roughly 69% of the students were Caucasian, 1% were African American, 10% were Hispanic, 16% were Asian and the remaining 4% belonged to two or more races. Only two percent of the students were considered to be economically disadvantaged (New Jersey Department of Education, 2016).

Classroom. The classroom where the study took place is a self-contained high school Chemistry classroom for students with exceptional learning needs. The classroom consists of a teacher desk, six desk pods, and six lab tables. The teacher has an overhead projector that connects to his laptop and a document camera. All students have their own Chromebook as provided by the district in the 1:1 technology initiative enacted in 2014. The teacher also instructs an additional variety of courses throughout the day, including

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sections of general level collaborative chemistry and self-contained biology for students with severe autism. The study was conducted during two different sections of self-contained chemistry.

Participants

This study included thirteen eleventh grade students: Ten of the students identify as male and three identify as female. Four students were identified as having ADHD. One student was classified as emotionally disturbed. Three students were identified as communication impaired; one student was identified as having autism, eight students were classified as having a specific learning disability, and one student has a history of depression and anxiety. Students exhibited a variety of weaknesses including in the areas of oral expression, basic reading skills, reading comprehension, reading fluency, written expression, math problem solving and math calculation, history of bullying peers, oppositional behavior, receptive/expressive language, following verbal directions, language processing, semantics, syntax/grammar, verbal reasoning, pragmatics, socialization, and processing speed. All participants had an IEP to meet their individual needs.

Students in the test group and control group have been chosen to be a part of either group based on which class section they attend, allowing for one section to be instructed heavily through the use of Google Classroom, and the other section to be instructed through traditional paper methods. The two class sections are considered to be equal in terms of rigor and content. Both sections and are taught by the same instructor. Students have been placed in these course sections through a collaborative effort between the previous year teacher and child study team.

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Table 1

Control Group Participant Data

Student	Age	Grade	Classification(s)
A	17 years old	Eleventh Grade	ED, SLD, ADHD
B	16 years old	Eleventh Grade	CI
C	17 years old	Eleventh Grade	SLD, ADHD
D	16 years old	Eleventh Grade	SLD
E	17 years old	Eleventh Grade	CI
F	16 years old	Eleventh Grade	SLD

Table 2

Test Group Participant Data

Student	Age	Grade	Classification(s)
G	16 years old	Eleventh Grade	ADHD
H	17 years old	Eleventh Grade	CI
I	16 years old	Eleventh Grade	SLD
J	16 years old	Eleventh Grade	SLD
K	16 years old	Eleventh Grade	SLD
L	16 years old	Eleventh Grade	Autism
M	16 years old	Eleventh Grade	SLD, ADHD

Research Design

This study used an experimental/control group design as well as a qualitative design. Thirteen participants across two classrooms participated. All of the students had been previously evaluated and were classified as eligible for special education under several categories of disability. All of the students had competency in the use of Google Classroom but had not yet used it in this class. The experimental group (7) used Google Classroom. The control group (6) continued instruction with traditional paper-based instruction.

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Procedures

During week one of the study, baseline data was collected to assess performance on turning in assignments, class discussions, and performance on assessments within the experimental and control groups. The experimental group took a survey addressing their perceptions of Google Classroom. During week one, students in both groups were given a score which serves as baseline for their turning in of assignments with differential points for being turned in on time, turned in late, or not turned in. Students in both groups were administered an assessment in the traditional paper form on the solutions unit and were assigned a score based on their performance on the assessment at the start of the eight-week unit. The assessment was taken from the district curriculum database, Rubicon/Atlas, and modified as per individual student IEP. For one of the weeks, week 6, in the test and control groups, quantitative data was collected by the teacher on the frequency of student contribution to class discussion and the amount that students contribute, and qualitative data was taken on student contribution to class discussion.

Week one can be considered a baseline and students in the experimental group began utilizing Google Classroom for all of their assignments, curricular materials, assessments, projects, and as an additional medium for class discussion. Students in the control group continued to receive instruction in the traditional method and participate in class discussion by face to face medium. The teacher collected data on the frequency of assignments handed in on time and at all for all students utilizing Skyward gradebook. After the eight-week instructional period, the teacher administered a second assessment post-test on the solutions unit and compared the data from the two classes quantitatively.

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Students in the experimental group took a second survey addressing their perceptions of Google Classroom as it relates to their performance in the Chemistry classroom.

This study took eight weeks to complete. During week 1 baseline data was collected on student participation, handing in of assignments on time, late, or at all, survey was given for student perceptions, pre-test was given based on district curriculum, and instruction was changed for the experimental group to being heavily delivered through Google Classroom, instruction continued as usual per the control group. During weeks 2 through 7 data was also collected on the above areas. During week 8, final data was collected in the above areas, post-test was given based on district curriculum, and post-survey was given to the experimental group.

Materials

Google classroom was used in the experimental group for access to all curricular materials, assessments, etc. Paper copies were used in the control group for all curricular materials, assessments, etc. Pre and Post survey was administered electronically to experimental group. Skyward gradebook was used to monitor student handing in work late or at all. The following tables will be used to record turning in of assignments in both the experimental and control groups as adapted from the Skyward gradebook. Table 5 will be used to record the results of the technology acceptance model measures.

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Table 3

Control Group assignment handing in on time (3), late (2), or not at all (1).

Student	W1	W2	W3	W4	W5	W6	W7	W8
A								
B								
C								
D								
E								
F								

Table 4

Experimental Group assignment handing in on time (3), late (2), or not at all (1).

Student	W1	W2	W3	W4	W5	W6	W7	W8
G								
H								
I								
J								
K								
L								
M								

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Table 5

Summary of Psychometric Properties of the measures

Construct	Measurement Instrument	Loading
Perceived Usefulness (PU) α = ρ =	Using GC will improve my course grades Using GC is better than using traditional paper assignments Overall, using GC will help me	
Ease of Use (EOU) α = ρ =	Google classroom is easy to use Completing Chemistry assignments through GC is easy GC will be easy to operate	
Attitude (A) α = ρ =	The idea of using GC is: (very bad - very good) The idea of using GC is (very foolish - very wise) Using GC would be (very unpleasant - very pleasant) Using GC is an idea: (dislike very much - like very much)	
Perceived Enjoyment (ENJOY) α = ρ =	I would find using GC to be enjoyable The actual process of using GC would be pleasant I would have fun using GC	
Behavioral Intervention (BI) α = ρ =	I intend to use GC regularly this marking period I intend to use GC this marking period to assist me to prepare projects, papers, and assignments I intend to use GC frequently this marking period	

(Lee, 2005.) - Note: Questions as shown above were adapted for the student population and specifics of the study.

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Dependent Variables

Turning in of assignments. Throughout the study, turning in of assignments was measured per week using a teacher scale. Students receive a score for each assignment of 3 for on-time, 2 for handed in late, and 1 for not handed in at all. An average is taken based on the total number of assignments for that week.

Performance on summative assessment. Students performance is measured on a pre-test and post-test based on the district curriculum of what is to be covered during the eight-week period.

Survey. At the beginning and end of the study, the test group participants were asked to complete a survey based on the technology acceptance model. Participants answered questions for each descriptor. The questions were presented to the students through google classroom forms. Students had a choice of 1-5, 1 being highly disagree and 5 being highly agree.

Quality of discussion. Student contribution to class discussion was measured using a teacher designed rubric. Based on student responses to prompt and comments to peers, scores were recorded for each student for one week.

Quantity of discussion. Frequency of student contribution to class discussion via online platform and face to face was measured for week 6.

Data Analysis

Survey results were collected and compiled into a table. Turning in of assignment scores were averaged and a standard deviation was calculated. The data for all variables were displayed in a table. Moreover, results from each variable were compared and

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converted into graphs for visual analysis. This comparison of results helped to determine the effectiveness of Google Classroom in these different areas.

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Chapter 4

Results

Both the test and control group were administered a pre and posttest. Individual student growth was calculated for all students. Average growth was calculated for each group. Standard deviation was calculated for the growth of each group. The results are seen in the tables and graph that follow.

Table 6

Control Group Growth - Tests

	Pre-Test Score	Post-Test Score	Growth (Post – Pre)
Student A	35	57	22
Student B	24	53	29
Student C	37	67	30
Student D	46	70	24
Student E	29	50	21
Student F	37	50	13

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Table 7

Experimental Group Growth - Tests

	Pre-Test Score	Post-Test Score	Growth (Post – Pre)
Student G	34	73	39
Student H	20	70	50
Student I	37	90	53
Student J	37	77	40
Student K	51	90	39
Student L	22	65	43
Student M	51	93	42

Table 8

Growth: Group Means and Standard Deviations

Control Group		Test Group	
Mean	Standard Deviation	Mean	Standard Deviation
23.17	6.18	43.71	5.59

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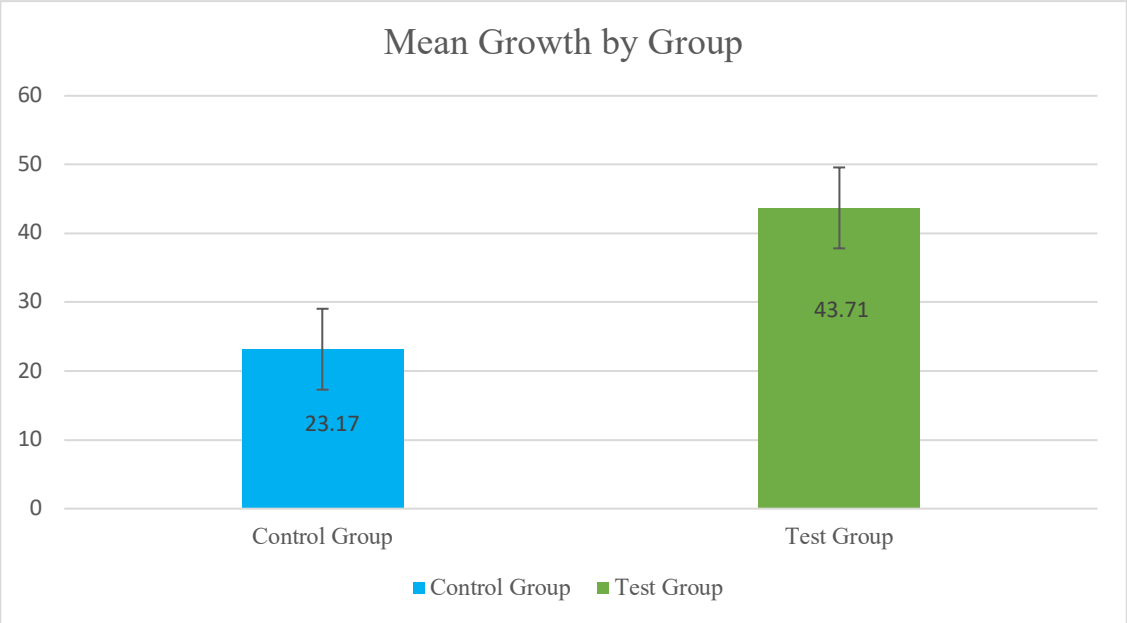

Figure 1. Mean Growth by Group

As shown above, all students in both the experimental and control group improved in terms of performance on the post-test compared to the pre-test. The students in the experimental group showed greater growth on average as compared to the control group.

The following data tables show scores for each student group on an individual weekly basis based on assignment turned in on time, turned in late, or not turned in.

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Table 9

Control group participant assignment handing in on time (3), late (2), or not at all (1).

Student	W1	W2	W3	W4	W5	W6	W7	W8
A	2	2	3	1	3	1	2	3
B	3	3	1	1	1	3	1	3
C	3	3	3	3	3	3	3	3
D	2	3	3	3	3	3	2	3
E	3	3	3	3	3	3	3	3
F	2	2	1	1	1	1	1	2

Table 10

Experimental group participant assignment handing in on time (3), late (2), or not at all (1).

Student	W1	W2	W3	W4	W5	W6	W7	W8
G	2	2	3	1	3	1	2	3
H	3	3	1	1	1	3	1	3
I	3	3	3	3	3	3	3	3
J	2	3	3	3	3	3	2	3
K	3	3	3	3	3	3	3	3
L	2	2	1	1	1	1	1	2
M	3	3	3	3	3	3	3	3

Table 11

Group Assignment Turning-In Score

Control Group		Test Group	
Mean	Standard Deviation	Mean	Standard Deviation
2.375	0.84	2.66	0.70

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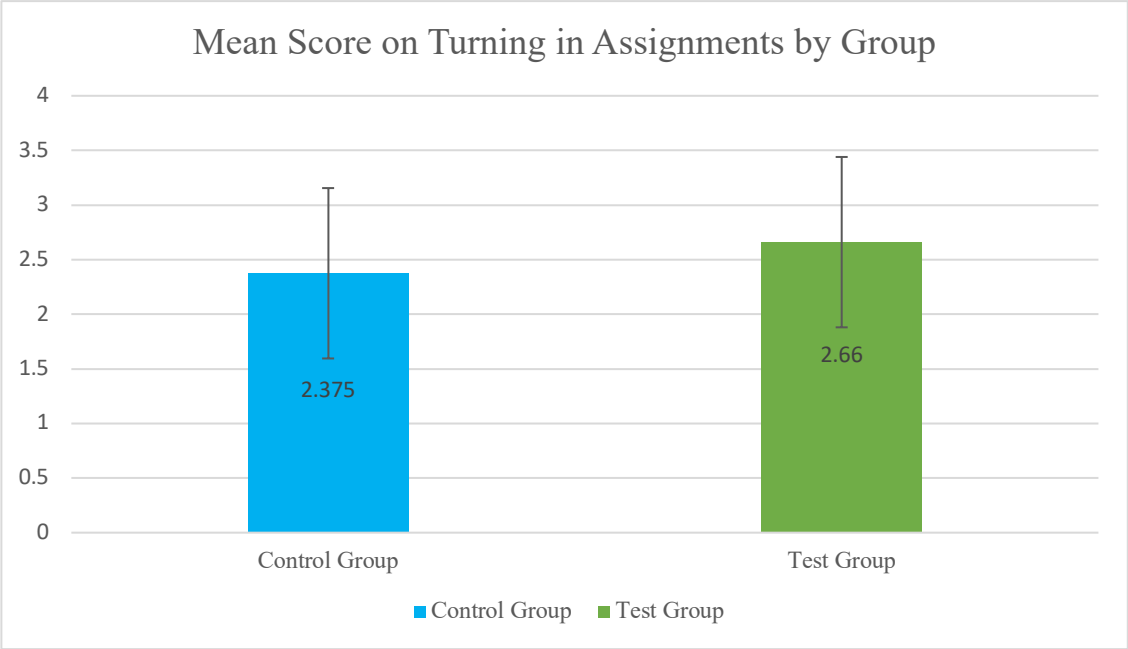

Figure 2. Mean Score on Turning in Assignments by Group.

As shown above, the experimental group showed a greater average score when it comes to turning in assignments. Overall, the results were found to be statistically insignificant. Individual trends varied greatly for students with the exception being if they turned in all assignments on time every week. Outside factors such as attendance, and over-involvement in extracurricular activities may have a larger role in student turning in assignment scores than the way assignments are turned in.

The following tables contain the data for the growth or regression overall in student ability to turn in assignments on time over the eight-week period. The table is adjusted such that students that showed zero change in turning in of assignments were excluded. Therefore, the tables shown below is the regression overall in student ability to turn in assignments for only students that demonstrate an inconsistency in this area over the eight-week period.

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Table 12

Control Group Student Growth or Regression – Turning in Assignments

	Week 1 Score (Baseline)	Week 2 to 8 Average Score	Change (Average - Baseline)
Student A	2	2.14	0.14
Student B	3	1.86	-1.14
Student D	2	2.86	0.86
Student F	2	1.29	-0.71

Table 13

Student Growth or Regression – Turning in Assignments

	Week 1 Score (Baseline)	Week 2 to 8 Average Score	Change (Average - Baseline)
Student G	3	2.57	-0.43
Student I	3	2.86	-0.14
Student J	3	2.86	-0.14
Student K	3	1.86	-1.14
Student L	1	2.43	1.43

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Table 14

Group Assignment Turning-In Regression

Control Group		Test Group	
Mean	Standard Deviation	Mean	Standard Deviation
-0.22	0.89	-.09	0.94

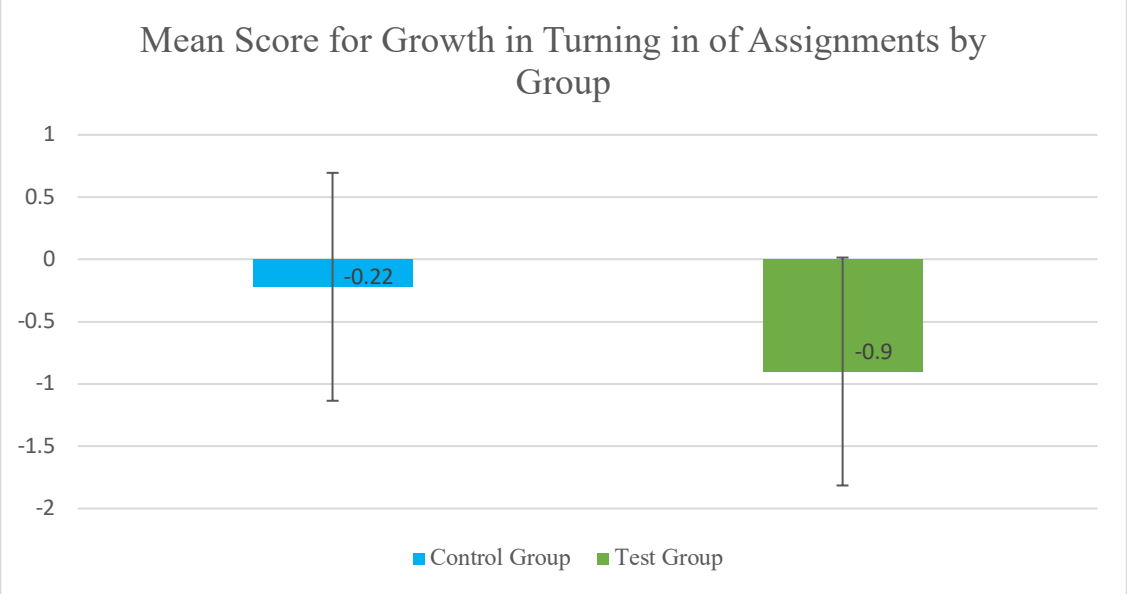

Figure 3. Mean Score for Growth in Turning in of Assignments by Group

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Students that turned in all assignments on time for all weeks of the study were excluded from this data analysis because there was no growth or regression shown. Two students in the control group showed regression when it comes to turning in of assignments and two students showed growth. In the experimental group, four students showed regression and one student showed growth. Overall, the results were found to be statistically insignificant. Individual trends varied greatly for students with the exception being if they turned in all assignments on time every week. Outside factors such as attendance, and over-involvement in extracurricular activities may have a larger role in student turning in assignment scores than the way assignments are turned in.

Student Surveys

All experimental group students completed a survey during week 1 and 8. Students rated the statements using a Likert scale of 1 through 5, with a score of 5 indicating "strongly agree," 4 "agree," 3 "undecided," 2 "disagree," and 1 "strongly disagree." Table 8 provides the percent of students who responded with each answer on the survey during week 8 for six of the most relevant questions. Table 15 provides the mean score for each statement during week 8.

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Table 15

Likert Survey Results – Experimental Group Week 8 - Percentages

Statements	Strongly Agree 5 (%)	Agree 4 (%)	Undecided 3 (%)	Disagree 2 (%)	Strongly Disagree 1 (%)
1. Google Classroom is useful when it comes to accessing and turning in assignments	71.4	28.6	0	0	0
2. Google Classroom is useful when it comes to class discussions	0	28.6	28.6	28.6	14.2
3. Having an online gradebook is useful.	57.1	42.9	0	0	0
4. Completing math based assignments on Google Classroom is useful.	0	0	42.9	28.6	28.6
5. I prefer to use Google Classroom over traditional paper-based instruction.	14.2	14.2	28.6	42.9	0
6. Taking tests or quizzes on Google Classroom is useful.	0	28.6	28.6	28.6	14.2

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Table 16

Likert Survey Results: Mean Scores for the Experimental Group

Statements	Mean Response
1. Google Classroom is useful when it comes to accessing and turning in assignments.	4.71
2. Google Classroom is useful when it comes to class discussions.	2.71
3. Having an online gradebook is useful.	4.57
4. Completing math-based assignments on Google Classroom is useful.	2.14
5. I prefer to use Google Classroom over traditional paper-based instruction	3.00
6. Taking tests or quizzes on Google Classroom is useful	2.71

The mean of student responses to statements 1 and 3 were a 4.71 and 4.57 respectively – indicating that on average students strongly agree with the statement. The mean of student responses to question 2 and 6 were both a 2.71 – indicating that on average students are either neutral toward or disagree with these statements. The mean of student responses for statement 4 was a 2.14 – indicating that on average students

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disagree with the statement. The mean of student responses to statement 5 was a 3.00 – indicating that students are neutral toward this question.

Table 17

Summary of Psychometric Properties of the measures

Construct	Measurement Instrument
Perceived Usefulness (PU) *α = 1.11* *p = 1.30*	Using GC will improve my course grades Using GC is better than using traditional paper assignments Overall, using GC will help me
Ease of Use (EOU) *α = 1.12* *p = 1.05*	Google classroom is easy to use Completing Chemistry assignments through GC is easy GC will be easy to operate
Attitude (A) *α = 1.11* *p = 0.68*	The idea of using GC is: (very bad - very good) The idea of using GC is (very foolish - very wise) Using GC would be (very unpleasant - very pleasant) Using GC is an idea: (dislike very much - like very much)
Perceived Enjoyment (ENJOY) *α = 1.12* *p = 1.14*	I would find using GC to be enjoyable The actual process of using GC would be pleasant I would have fun using GC
Behavioral Intervention (BI) *α = 1.11* *p = 0.62*	I intend to use GC regularly this marking period I intend to use GC this marking period to assist me to prepare projects, papers, and assignments I intend to use GC frequently this marking period

Note: *α* = composite reliability; *p* = average variance expected.

As shown above in Table 13, composite reliability and average variance accepted are in acceptable ranges as outlined by Lee (2015).

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Correlational tests were run between each of the constructs. Each place where the constructs meet in the table provide data which can be used to ascertain if there is a correlation between student responses to statements that deal with one construct in relation to students' responses to statements that align to the other construct. Results are shown in Table 18 below.

Table 18

Correlation Matrix of the Constructs

	PU	EOU	A	ENJOY	BI
Perceived Usefulness (PU)	1				
Ease of Use (EOU)	0.08	1			
Attitude (A)	-0.09	0.45	1		
Perceived Enjoyment (ENJOY)	0.27	0.39	0.54	1	
Behavior Intervention (BI)	0.44	0.18	0.27	0.34	1

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A positive correlation was shown between all constructs, with the exception of Attitude and Perceived Usefulness. Similar results were shown in the study conducted by Lee (2015) with university level students.

Student Contribution to Class Discussion scores are seen below in table 19.

Table 19

Experimental Group Discussion Scores

	Face to Face	Via Google Classroom
Student G	17	3
Student H	13	7
Student I	20	13
Student J	20	7
Student K	13	3
Student L	17	3
Student M	20	13

Table 20

Experimental Group Discussion Scores

Face to Face		Via Google Classroom	
Mean	Standard Deviation	Mean	Standard Deviation
17.1	3.13	7.00	4.47

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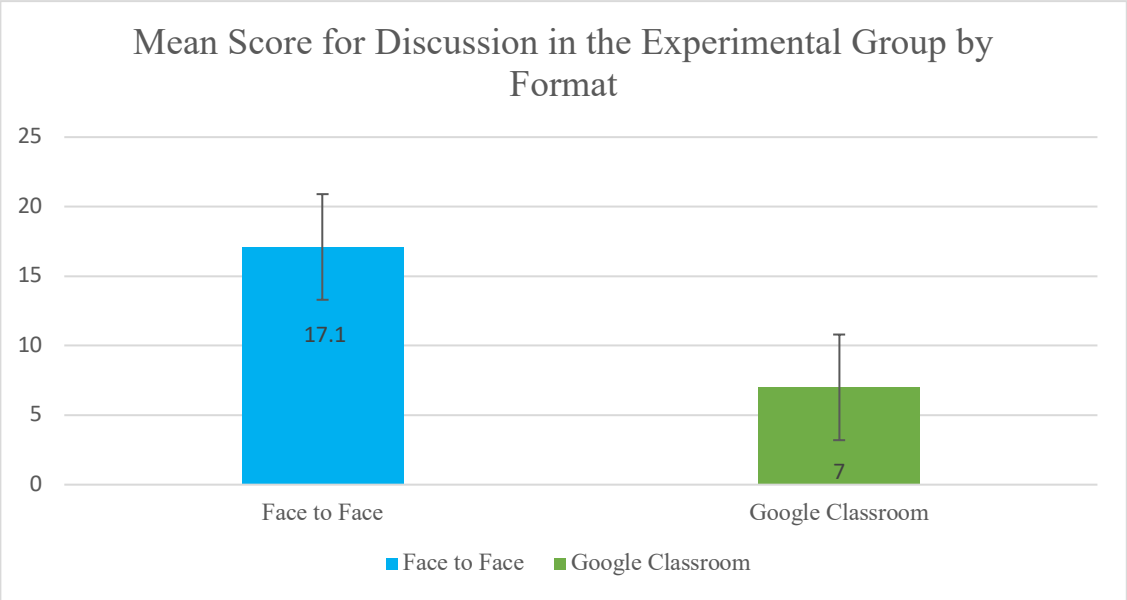

Figure 4. Mean Score for Discussion in the Experimental Group by Format

Students scored higher when it comes to class discussion through the face to face format. All individual students in the experimental group scored high through the face to face format in comparison to the Google Classroom format. These results were found to be statistically significant.

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Chapter 5

Discussion

The purpose of the present study was to investigate the effects of Google Classroom on the performance on curriculum-based assessments and the turning in of assignments in the self-contained high school Chemistry classroom. In addition, student perceptions on the use of this learning management system (LMS), assessing student acceptance of the LMS following the TAM framework, and student contribution to class discussion were evaluated when it comes to the differences in medium (face to face vs. Google Classroom).

Findings

Students in the experimental group as a whole showed greater growth when comparing the differences in performance between the pretest and posttest. Students in the experimental group showed about double the amount of growth as compared to the control group. These results were found to be statistically significant. While these results favor Google Classroom as opposed to traditional paper-based teaching, it is important to note that ongoing informal observations during the eight weeks of instruction performed by the researcher would suggest that students in the experimental group focused on the work given to them more readily and showed greater engagement in the content. They appeared to be searching for and producing answers as a means to an end. Whereas, informal observations of the control group show that students asked more questions and showed greater collaboration. While the experimental group performed better on the post-test, it would be interesting to

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see if similar results would be seen given a practical application test as a means of demonstrating understanding of content.

Surprisingly, students in both groups showed regression when it came to scores for turning in assignments over the eight-week period. Informal observation completed by the researcher on of all students that are currently taught in all sections would suggest that this pattern is common within the student body at this time of year. The study took place during the long stretch between winter break in December and spring break in April with limited breaks in between as per district calendar. Nevertheless, students in the experimental group scored higher when it came to turning in assignments. However, these results were not found to be statistically significant. It is important to note that many outside factors occur which can lead to variance in individual student performance. For instance, student L scored poorly during weeks one through four - a time where she stated she was over-involved in extracurriculars to the point where she would not get home until bedtime. After week four, the students extracurriculars had ended and her scores improved drastically. Similarly, student B demonstrated a drastic regression in score during weeks three through five - this was a time where the student had frequent absences due to college visits and athletic recruitment all over the country. There were significant outside factors at play that can affect student performance when it comes to turning in assignments in both the experimental and control group. Therefore, it is not possible to say based on the data whether implementation of Google Classroom is beneficial to students turning in assignments. Future studies

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could include a larger sample size to offset these inconsistencies based on individual student circumstances.

When asked about their perceptions of using Google Classroom, the majority of students agreed or strongly agreed with the statement, "Google Classroom is useful when it comes to accessing and turning in assignments." This suggests that students find the LMS suitable as a means of accessing course materials and turning in assignments.

Student responses to the statement, "Google Classroom is useful when it comes to class discussions" varied. The mean of student responses would suggest that overall students feel neutral toward or disagree with the statement. This could suggest that students still prefer to have discussions face to face despite the ubiquitous technology that abounds.

The majority of students agreed or strongly agreed with the statement, "Having an online gradebook is useful", This suggests that students find the LMS helpful when it comes to tracking their grade and staying on top of their assignments.

Student responses to the statement, "Completing math-based assignments on Google Classroom is useful" varied. The mean of student responses would suggest that overall students disagree with the statement. This could suggest that students prefer to carry out math-based assignments on paper.

Student responses to the statement, "I prefer to use Google Classroom over traditional paper-based instruction" varied considerably. The mean of student responses would suggest that overall students are neutral toward the statement. This

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could suggest that student preference for method of instruction varies considerably depending on the individual.

Student responses to the statement, "Taking tests or quizzes on Google Classroom is useful" varied. The mean of student responses would suggest that overall students are neutral toward or disagree with the statement. This could suggest that overall students would prefer to take tests or quizzes through traditional paper-based formats.

According to the results of the correlation matrix of the constructs results following the TAM framework, a positive correlation was shown between perceived usefulness and ease of use, perceived enjoyment, and behavior intervention. A positive correlation was also shown between ease of use and attitude, perceived enjoyment, and behavior intervention. Positive correlations were also shown between attitude and enjoyment and behavior intervention, as well as between enjoyment and behavior intervention. The only negative correlation shown was between perceived usefulness and attitude, which was also found in the study conducted by Lee (2005). This can be attributed to students growing up in the information age, no longer having any qualms or anxieties when it comes to using internet applications. All results were found to be significant because the composite reliability and average variances were within the acceptable ranges as outlined by Lee (2005). These results are similar to the findings of Lee (2005) and would suggest that overall students accept Google Classroom as an instrument of technology and that students have positive attitudes toward Google Classroom as an LMS.

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The results of the student scores for discussion were distinctive and statistically significant. Students scored overwhelmingly higher during face to face class discussions. This could suggest that face to face discussions could be more developmentally appropriate for students in the self-contained high school Chemistry classroom. Informal teacher observations would suggest that students benefit from having the teacher acting as a facilitator of class discussion in real time.

Limitations

One limitation of this study was the sample size. Due to the limited number of individuals that participated in the study it was difficult to get clear results when it came to turning in of assignments. Individual outside circumstances such as extended periods of absence and overinvolvement in extracurricular activities make it difficult to come to a consensus as to whether or not Google Classroom leads to improved student performance when it comes to turning in assignments. A larger sample size would be able to compensate for these individual variations. Additionally, the timing and duration of the study likely had impacts on the data. The study only lasted eight weeks and occured during a time of year when students are informally known to lose steam - possibly explaining the regression in student scores for turning in assignments. If the study had lasted longer or occured at a different time of year, it is possible that the results of this measure could have varied considerably.

Another limitation is the bias that often arises when giving a content-based, multiple choice assessment. While students in the experimental group did show greater growth between the pretest and posttest than the control group, it is possible

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that this result was due to the delivery of instruction streamlining their efforts toward coming up with answers during their assignments as a means to an end, compromising a focus toward an abstract understanding of the content and a true understanding of science and the rules that govern the universe. The two groups could have been given a practical, hands-on, pretest and posttest in addition to a content-intensive multiple-choice pretest and posttest assessment.

A final limitation is the preparing of students for use of technology to facilitate classroom discussions. The overwhelmingly poor performance of students when communicating with each other via online format was unanticipated. It is possible that different results would have arisen if the researcher had explicitly taught and modeled proper online classroom communication and given it a trial run prior to initiating discussion.

Implications and Recommendations

The results suggest that it might be beneficial to work toward striking a healthy balance between using learning management systems and traditional paper-based methods in the self-contained secondary Chemistry classroom. Perhaps an LMS such as Google Classroom should not be used as extensively for discussions as it is in the general education classroom. Additionally, perhaps a learning management system should not be used when dealing with math intensive content or students should be given a choice in this matter as most students found completing math-based science assignments to be difficult through the LMS. Results of the TAM show that students overall accept LMS such as Google Classroom as part of their technology artillery. In addition, because it has been replicated that there is no

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positive correlation between perceived ease of use and attitude toward use of the LMS - there is strong support that students of this population and beyond arrive to class without anxiety about technology that has been seen in previous generations.

The present study both corroborates findings from the literature done by Lee (2015), and such findings have been extended to the present student population. When it comes to the technology acceptance model, the findings were similar if not the exact same. This suggests that eleventh grade students in the self-contained secondary Chemistry classroom are at a stage of development where their acceptance of the use of an LMS rivals that of university students.

With that being said, more research is needed in this student population when it comes to running discussions and turning in assignments through Google Classroom. Long-term studies that include collection of maintenance data to assess whether improvements are maintained over time are warranted. Additionally, research should be conducted that focuses on student performance during practical assessment rather than just multiple choice assessments. Finally, research using larger groups of students, as well as with groups that include students without disabilities, should be conducted.

Conclusions

The present study supports the use of Google Classroom with students with disabilities in the self-contained secondary Chemistry classroom. After receiving instruction through the use of the Google Classroom platform, student scores on a content-based multiple-choice assessment improved compared to their peers that were given traditional paper based instruction. The usefulness of this technology for

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discussion purposes in this setting remains unclear. Overall students perceive this technology favorably, except for when it comes to working through math-based problems.

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