

BLENDING LEARNING IN HIGH SCHOOL CHEMISTRY

by

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DEDICATION

I would like to dedicate my work first to my Lord Jesus Christ. Without you I would be completely lost. It was only by your wisdom, grace and favor that I could accomplish this. To my husband Josias, who always loves, believes, encourages and supports me to keep going. To my twin daughters Alexandra and Andrea who are my constant reminder that with God everything is possible. Finally, to all my students who challenge me to be the best teacher I can be. I love you all!

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ABSTRACT

The purpose of this research was to see how the use of blended learning and online resources would help chemistry students improve their understanding of difficult chemistry topics and reduce their stress level. The research was carried out in a regular chemistry class, in a five-week intervention with the Mole Unit. The blended learning consisted of students watching videos at home, school or both and then working with classroom activities that fostered active learning. The results indicated that blended learning, use of visual aids and homework reinforced the knowledge learned in class and prepared students for exams.

CHAPTER ONE

INTRODUCTION AND BACKGROUND

Context of the Study

I work at Westminster Academy in Fort Lauderdale, Florida. We are a private college prep PK2-12 school. The number of students in total is eight hundred and fifty-seven students (J. Camejo personal communication, March 25, 2019). Our student population is Caucasian 64.5%, African American/ Black 13.6%, Hispanic 10.7%, Bi-racial 4.9%, Asian 3.5%, Middle East/Arab 0.5%, Native American 0.4% and Other 2.2%. Westminster Academy is a Christian college preparatory school ministry of Coral Ridge Presbyterian Church. Our school logo is "Westminster Academy is a Christ-centered, biblically-based college preparatory school dedicated to equipping covenant students to excel by using their gifts and talents for God's glory" (WA, 2019).

For my classroom research project based in the action research model, I chose to work with my regular chemistry class that consist of two periods with 35 students in total. In this class, the ethnic diversity is 2.8% Asian, 22.2% African American/ Black, 8.3% Hispanic or Latino, 5.6% Biracial and 61.1% Caucasian. This is an average class and well-rounded one. Students are either involved in one of several sports or the arts program. In this class, there are students with different degrees of learning disabilities.

Students who have varying degrees of learning disabilities in our school are called the Bridge Students. I have had many Bridge Students in my classes, but over the years I have been saddened, challenged and encouraged to better understand, help and work with

them. In particular, I had a student with severe ADHD, and I could not help him. I realized that if I could understand what my student was going through, perhaps I would be able to give him help.

The regular chemistry class I chose for this study was considered by teachers to be a challenging class over the years. Several factors influenced this. One element was teachers' lacking the knowledge to work with learning disabled students. Many of these students had been labeled as low performance and they believed it (Black & Wiliam, 1998), even though they had the potential for much more. Another factor was that some students had low motivation and did not want to work more than needed, even though they had the potential. They were comfortable with just passing the class with a minimum of work. Also, the great majority of these students were involved in extracurricular activities such as sports and the arts program. They sometimes got home from training or games at eight or nine in the evening. This meant that they had little or no time to do homework. Some said that they were too tired to do it. I also chose to work with this class to have a better understanding of my students. I wanted students to see how their investment in studying, using blended learning, might improve their understanding of chemistry and their grades.

Focus Question

My desire to work with these students lead me to wonder if using blended learning and other online resources would help their understanding of chemistry, resulting in higher grades. The purpose of this research was to see how the use of blended learning and online resources will help regular chemistry students improve their understanding of

difficult chemistry topics. I chose the following focus question for my action research project, How has the use of blended learning helped both my chemistry students and the Bridge Students improve their understanding of chemistry?

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Introduction

One paradox that many teachers see is students who appear to be gifted, smart and intelligent, yet have visible signs of learning disabilities. Are these students gifted? Are these students disabled? How could it be classified? Could it be both? There is no general agreement. Some consider a student gifted when they are exceptional in all areas. Others believe that a below average level in school indicates a student with learning disabilities. Studies have revealed that it can be a combination of both. There are children who are both gifted and learning disabled displaying extraordinary talents or strengths in some areas and incapacitating or weak traits in others (Babum,1990; Brody, & Mills, 1997). So how can these students be assisted? One way is using blended learning.

Defining Blended Learning

There are many diverse definitions given for K-12 blended learning. Some definitions include what blended learning should be and the tools to be used. Blended learning has been defined as a formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and pace (Horn & Staker, 2014). Blended learning can also be defined as a combination, mix or blending of face-to-face instruction and online learning. In the end, blended learning curricula can offer differentiated learning options with diverse positive

outcomes for the student (Melluzzo & Brodersen, 2017; Means, Toyama, Murphy, & Baki, 2013; Watson, Gemin, & Coffey, 2010).

Blended learning is a combination of quality instruction and teaching time, reinforced with resources that will provide a diverse learning style to the student. It can be most effective when the diverse needs of students are considered and met through diverse instruction (Larkin, 2019).

Blending Learning and Remediation

Blended learning can be used for remediation. According to the MAP Growth College Readiness Benchmarks Study (2019), average American students are not on grade level or ready for college. Many students need some sort of remediation to obtain the skills needed to succeed in their current grade level, in their future classes or to be ready for college. Students can move at their own pace to master in specific skills. When done in this way it creates individualized remediation. Most students will succeed in using this method. Students should continue to be exposed to grade-level standards at the same time remediation is being implemented. Blended learning finds ways for students to catch up. Small groups and individualized learning should always be available, because students learn much from peer- learning experiences (Anthony, 2018).

Anthony advises teachers not to isolate students from grade level material. Focusing only on what the student needs to learn to close the learning gap neglects the rest of the material their classmates are learning. The goal is for the student to catch up, not to fall behind. It is also important not to isolate students from one another. When students rely on technology only to remediate, the student is working by himself, doing

online assignments or assessments. Using a small group for instruction helps students interact with each other and learn from their small group. Even though some students will like to work by themselves, peer help is important as well as personalized instruction (Anthony, 2018).

Resources that Support Blended Learning

There are many resources that support blended learning. Google Classroom, Edmodo and Canvas have several features in common. These are free resources that enable teacher organization, the sharing resources, and student collaboration through polls, quizzes, and other assignments. Two other popular resources, Bozeman Science and Khan Academy utilize videos for students learning (Andersen, 2019; Khan Academy, 2019).

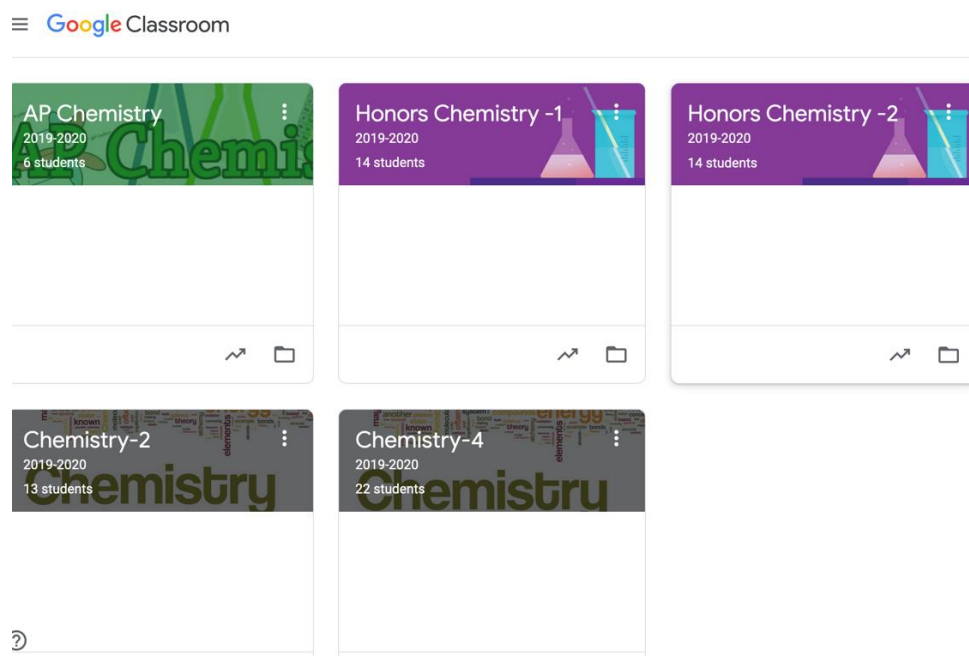


Figure 1. Google Classroom, 2019-2020.

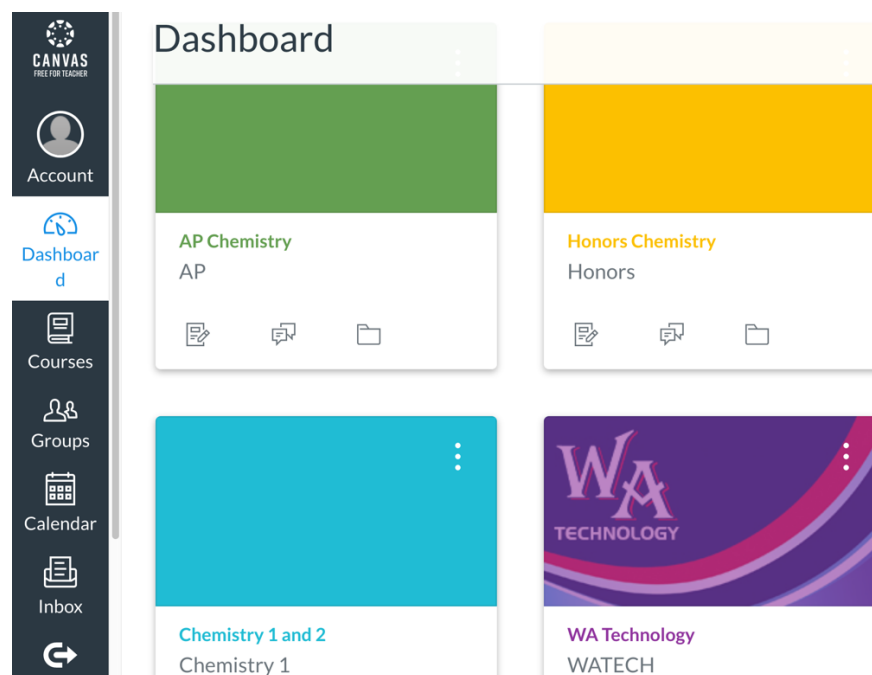


Figure 2. Canvas, 2019-2020.

Possible Benefits of Blended Learning

The result of several studies revealed that students' performance was better when having electronic assessments, rather than traditional paper assessments. The use of different platforms like Blackboard, Canvas, and Google Classroom as a collaboration to teachers' lectures, that is used in blended learning, has been studied and reported to improve students' achievement (Baleni, 2015; Hamad, 2017).

Another benefit from blended learning is that students learn from each other's discussions and small groups. Learning is made possible by different methods such as in-class lecture, videos, online assessments, small groups, and direct individualized instruction. Lessons can be watched again for review or when absent from class, so no

student stays behind. Students are more engaged in a blended classroom than just the traditional lecture setting. Studies report that students favor this style of learning. One drawback of blended learning is the limitation of technology such as having the appropriate device or quality internet access (Hamad, 2017; Hesse, 2017).

Blended learning is equivalent to, or perhaps even better than traditional learning.

However, attractiveness and efficacy among studies makes blended learning more appealing. In conclusion, blended learning has the potential to improve education when thoughtfully designed (Spanjersa, et al. 2015).

CHAPTER THREE

METHODOLOGY

Introduction

My classroom research project sought to determine if students improved their understanding of chemistry and reduced anxiety levels using blended learning. The main goal of the project was to improve students' understanding of chemistry in The Mole Unit. Students have struggled with this unit over the years. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for work with human subjects was maintained (Appendix A).

The study was carried out in my regular chemistry class which consisted of two sections. Three students were 12th graders, 28 students were 11th graders and 4 students were 10th graders. Data was collected from two periods of regular chemistry students with 35 students in total. As pre-requisite these students have already taken two years of science and most were taking Algebra-2.

Intervention

My research project was done in a five-week intervention that started the last week of January and finished on the last week of February 2020. We worked in an A/B day block schedule of 90 minutes each. Students attended chemistry class on A day during second- period and fourth- period class. The intervention for my classroom research project consisted of the usage of blended learning for The Mole Unit. Previous

to this intervention students were taught using the traditional directed instruction method. This included lecture, homework, and lab activities. The blended learning consisted of students watching instructional videos at home, school, or both, and then working with classroom activities that fostered active learning.

Data Collection

Prior to the research unit on moles, students learned to balance equations and identify different types of reactions. The conversions were done between grams and moles. Students learned how to analyze, and problem -solve. When working with problem-solving, sometimes students over-analyzed a question and got frustrated with the information given. They also focused on the unnecessary parts of the problem and forgot what was important.

One teaching strategy used was Edpuzzle. Edpuzzle is a learning platform where students not only watch a video, but the teacher could leave voice notes, and asked questions to determine if students were understanding the topic covered. Students were assigned during class time or at home to work with Edpuzzle. Students had to watch different tutorial videos which contained questions and problems. Students answered as they worked at their own pace. They were then introduced to The Mole Unit. We started with what was a mole and then we worked with different videos and conversion problems between mole and grams and grams to moles. Students finished the assignment at home.

At the beginning of class, students completed a Minute Paper for their journal work (Appendix B). Two questions were used that asked students what they learned from this lesson and what they were struggling with. To score the students' responses, I

separated the papers into three categories for the question about what they learned. The categories were as follows:

1. Excellent: the student showed signs that the three objectives were learned. The student understood and could apply the lesson.
2. Good: the students showed signs of learning one or two objectives. The student understood most of the lesson but had some gaps.
3. Poor: No objectives learned at all. The student missed what the main topic was about.

When scoring the responses, papers were further divided into three categories:

1. No help needed: the students felt they understood everything.
2. Help needed: the students had some questions about the lesson.
3. Irrelevant to the topic but help needed in another area.

The scores were analyzed using a t- Test.

Another form of data collection used was the Documented Problem-Solution (Appendix C). The learning goals essentials for students were to develop problem-solving skills, improved mathematical skills and learned techniques, and methods used to gain new knowledge on the subject. I chose this assessment because I wanted to know if students were learning how to analyze, set, and solve a problem after a new topic was taught and homework was done.

The Documented Problem-Solution was used with mole calculations. Students learned how to approach, analyze and solve the mole problems. As a tool for students to

understand and visualize the different steps needed a diagram called the cloud was given (Appendix D; Figure 3).

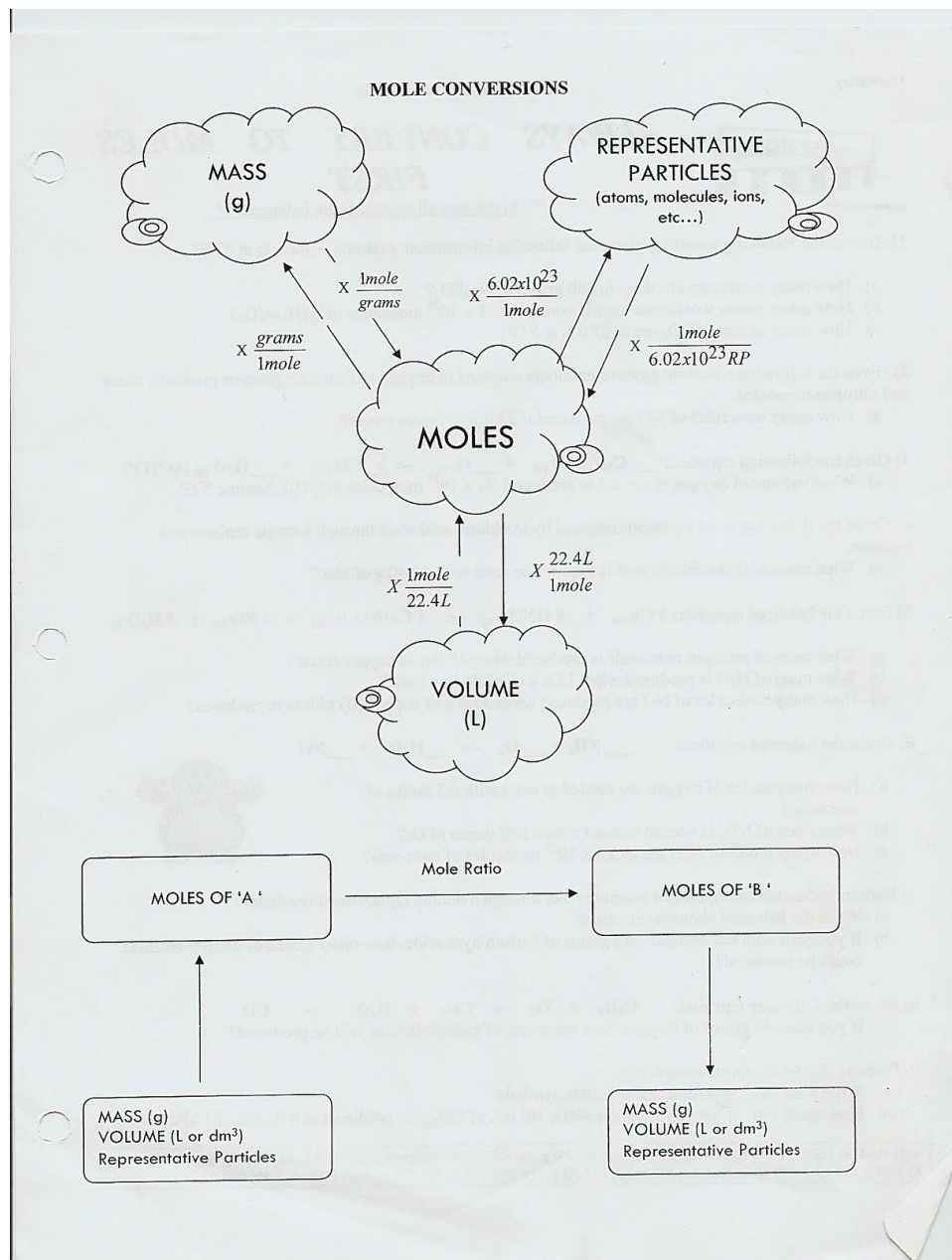


Figure 3. The cloud diagram (source unknown).

Students were also assigned homework. I modified the activity by not actually giving two problems to solve, but by applying the knowledge to solve the problem.

Students were given two questions that were written on the board. They had to draw and label the cloud and explain in detail how to use the cloud to solve stoichiometric problems to someone who had not been in class. Students were given between five to ten minutes to answer the questions. Papers were collected and then given to a different student to be edited. It was explained how they had to read their classmates' response, and they were to add any more information if needed. At the end of the assignment, students had to give back the edited papers to their respective proprietary. Each student was able to see what was added to their papers, and then they handed in their papers to the teacher. For scoring this assignment, I read each question completely and added information where needed. Then the papers were divided into three groups:

1. Students who completely understand and can explain how to solve mole problems using the Cloud. Students who are on track.
2. Students who have some gaps.
- 3 Students who need help immediately from the teacher in order to catch up with the rest of the class.

Students' grades during the intervention included quizzes and tests. These grades were compared to pre-intervention classes, the previous chemistry class 2018-2019, to determine if the blended learning style was a success or not.

Finally, a Pre-Treatment Chemistry Likert Survey-1 and Post- Treatment Chemistry Likert Survey-2 were given, using Google Classroom (Appendix E). I gathered students' opinions in a ten questions survey of how students may or may not describe the way they learned chemistry, and to determine their stress level. It was

utilized a Likert scale where they could agree, tend to agree, tend to disagree or disagree with the statement given. These surveys were evaluated by comparing the two survey results, looking for trends related to change in the way students thought they learned chemistry better and to see the level of anxiety using different teaching methods. The two Pre-Treatment Chemistry Likert Survey-1 and Post- Treatment Chemistry Likert Survey-2 were analyzed.

CHAPTER 4

DATA ANALYSIS

The Minute Paper

The results of the Minute Paper indicated that 2.85% of the students gave an excellent response, when asked the question, what did you learn from this lesson? Explain ($N=35$). One student wrote, "I learned how to solve the equations properly. I learned that a mole is a huge number that we cannot comprehend. I learned that we need the number 6.02×10^{23} in order to change formula units to moles." Sixty-five percent of the students' responses were good. One student wrote, "I learned that $1 \text{ mol} = 6.02 \times 10^{23}$. Avogadro's number. I learned how to set the equation using a cross; I learned how to use Avogadro's number as a conversion factor for atoms, molecules, particles and formula units. Also, that a mol is very important to chemistry." Thirty-one percent of the students rated poor. An example from one student was, "significant figure, scientific notation, moles aren't just an animal or a wart on your auntie face, I learned how to set up a formula" (Table 1).

Table 1. Students' response to What have you learned from this lesson?

Excellent (Student understood and could apply topic)	2.85%
Good (Student understood most of the lesson but had some gaps)	65.72%
Poor (Student missed completely what the main topic was about)	31.43%

For the second question, what are you struggling with? the results of the Minute Paper indicated that 5.71% of the students answered that no help was needed ($N=35$). The

student did not need any help they understood everything. Sixty-eight percent of the students said help was needed ($N=35$). They had some questions from the lesson.

Students were struggling understanding Avogadro's number, how to set a problem and the use of the calculator (Table 2). Finally, twenty five percent had questions irrelevant to the topic ($N=35$).

Table 2. Students' response to What are you struggling with? prompt.

No help needed (students felt they understood everything)	5.71%
Help needed (students had some questions about the lesson) a) struggling with understanding Avogadro's number - 25.0 % ($N=24$). b) struggle is how to set a problem - 62.5% ($N=24$). c) struggled with using their calculators - 8.3 % ($N=24$).	68.57 %
Irrelevant to the topic but help needed in any other area- 4.2 % ($N=24$).	25.72%

Documented Problem-Solution

The results of the Documented Problem-Solution based on category one to draw, label and explain the cloud in detail indicated that 62.86% were on track, goal achieved ($N=35$). They could draw the cloud but had problems in labeling one side of the cloud; specifically, from grams to moles six had this problem. From moles to representative particles, two students had problems labeling that side, so in total 22.86% percent of the students had some gaps ($N=35$). Finally, 14.28% needed help ($N=35$). It was discovered

that four students had the idea of the cloud but could not label it and one student was completely lost.

For category two, analyzing and solving problems, the results indicated that 42.86% of the students were on track, goal achieved. The students learned how to analyze and solve mole problems ($N=35$). Twenty-five percent had some gaps ($N=35$). Finally, 31.42% needed help ($N=35$).

For the Documented Problem-Solution Assessment activity, two concepts were analyzed, one was to draw, label and explain the clouds in detail and the other concept analyzed and solving problems. The results were analyzed using a bar graph to indicate the percentage of students on track, with gaps and the ones that needed help (Figure 4).

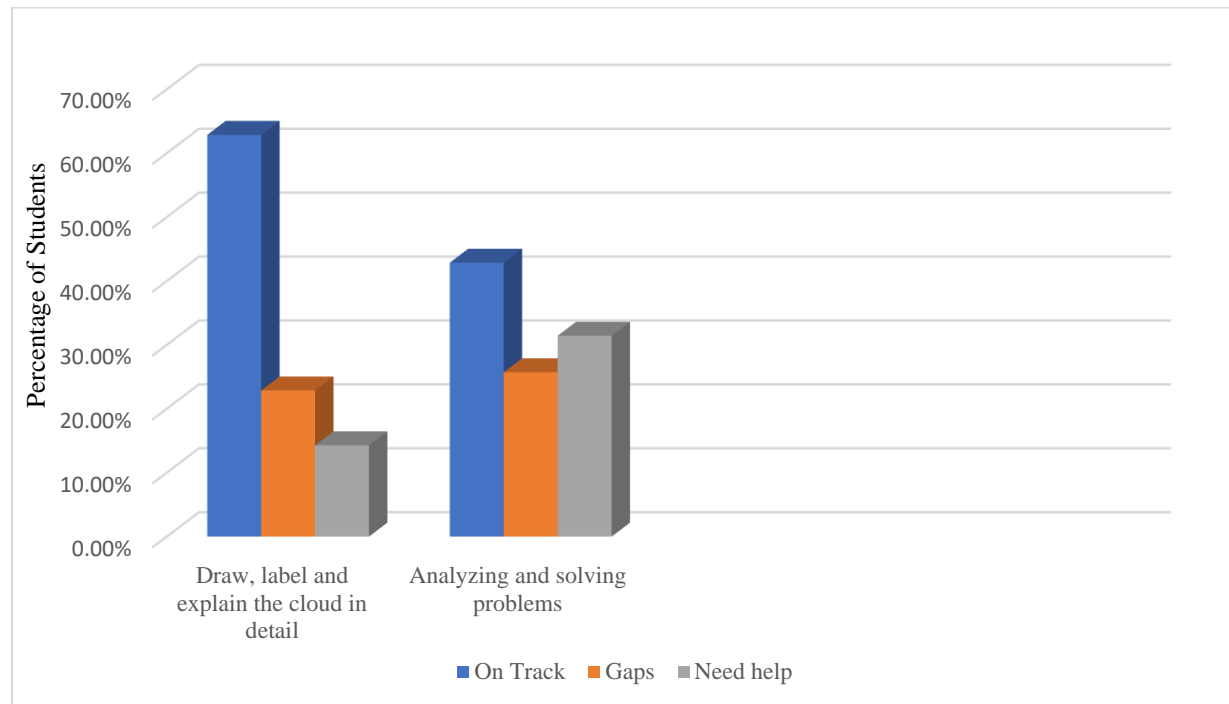


Figure 4. Documented Problem-Solution assessment activity the mole, ($N=35$).

On-track students wrote comments like the one following. “To convert from grams to representative particles; you take the amount of given grams of the element, multiply them by 1 mole, then divide by the # of mass grams, whatever that equals you put into step two of the problem you take the # of moles (the answer to the last equation, multiply by Avogadro’s # of 6.02×10^{23} RP then divide by 1 mol that will get you your representative particles.” Another student wrote, “To convert from moles to grams of a compound you take your given amount of moles multiply by # of elements grams divide by mol” (Figure 5).

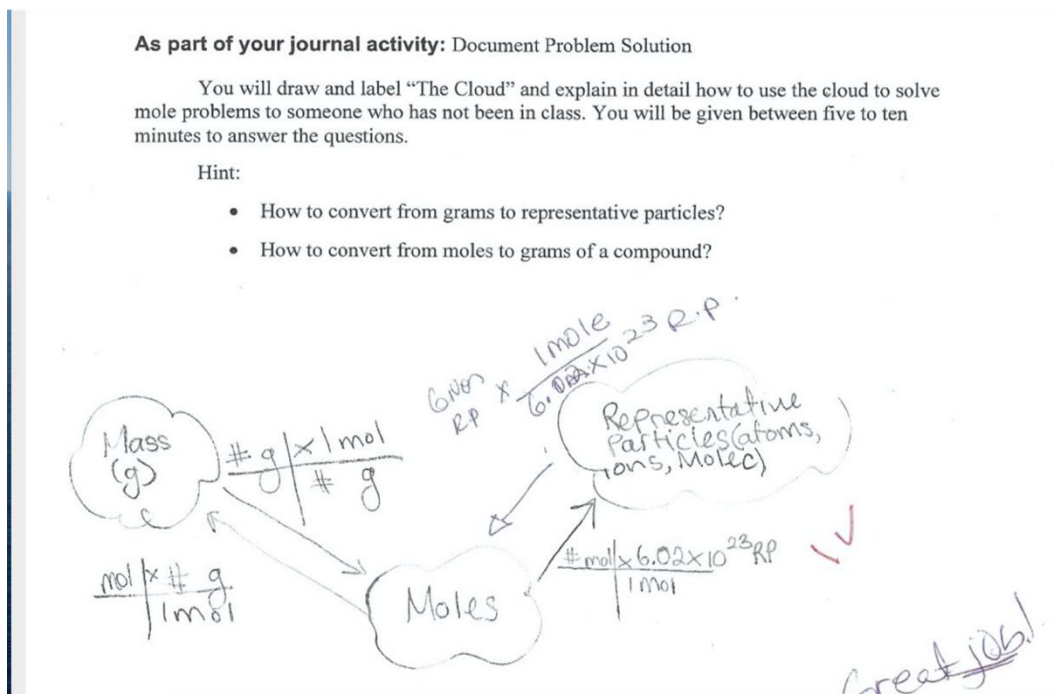


Figure 5. Documented Problem-Solution activity the Mole. Students can draw, label and explain the cloud in detail. This student is considered on track.

Students who have gaps in analyzing problems wrote comments like this: “To convert $m \rightarrow$ to g you use either 1 mole/ 1 g or the reciprocal to find how many grams are in the compound”.

Below is an example of a student who needs help. This cloud was edited. Missing information was added by peer review and teacher (Figure 6).

As part of your journal activity: Document Problem Solution

You will draw and label “The Cloud” and explain in detail how to use the cloud to solve mole problems to someone who has not been in class. You will be given between five to ten minutes to answer the questions.

Hint:

- How to convert from grams to representative particles?
- How to convert from moles to grams of a compound?

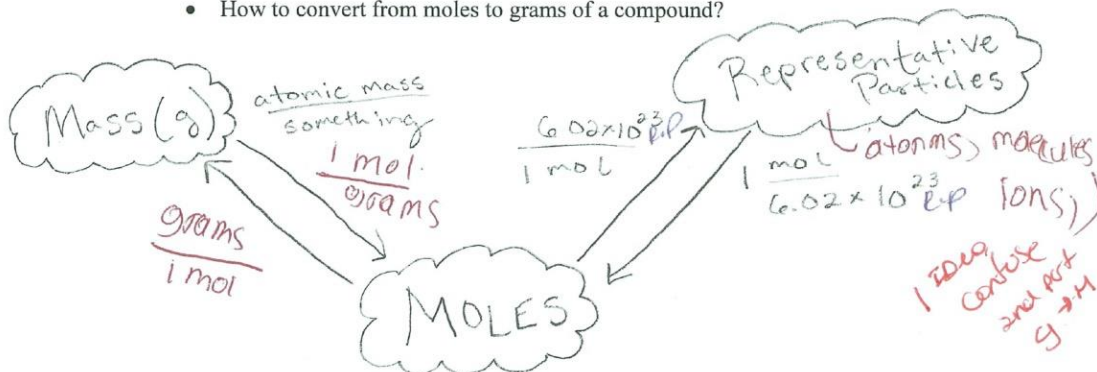


Figure 6. Documented Problem-Solution activity the Mole. A student with gaps in drawing, labeling and explaining the cloud in detail.

Another task given was to explain in detail how to use the cloud to solve mole problems to someone who has not been in class. Some students left this part in blank. They could not explain in words how to solve a mole problem. Another student attempted to explain but it did not really make sense. “To convert from grams to representative particles you have to start from grams to convert to moles, you have to see

on the cloud and look for formula that converts grams to moles. You write the given and set up your equation which will be given $1 \text{ mole} / 6.02 \times 10^{23}$. when you get your answer look at the cloud.” (Figure 7).

As part of your journal activity: Document Problem Solution

You will draw and label “The Cloud” and explain in detail how to use the cloud to solve mole problems to someone who has not been in class. You will be given between five to ten minutes to answer the questions.

Hint:

- How to convert from grams to representative particles?
- How to convert from moles to grams of a compound?

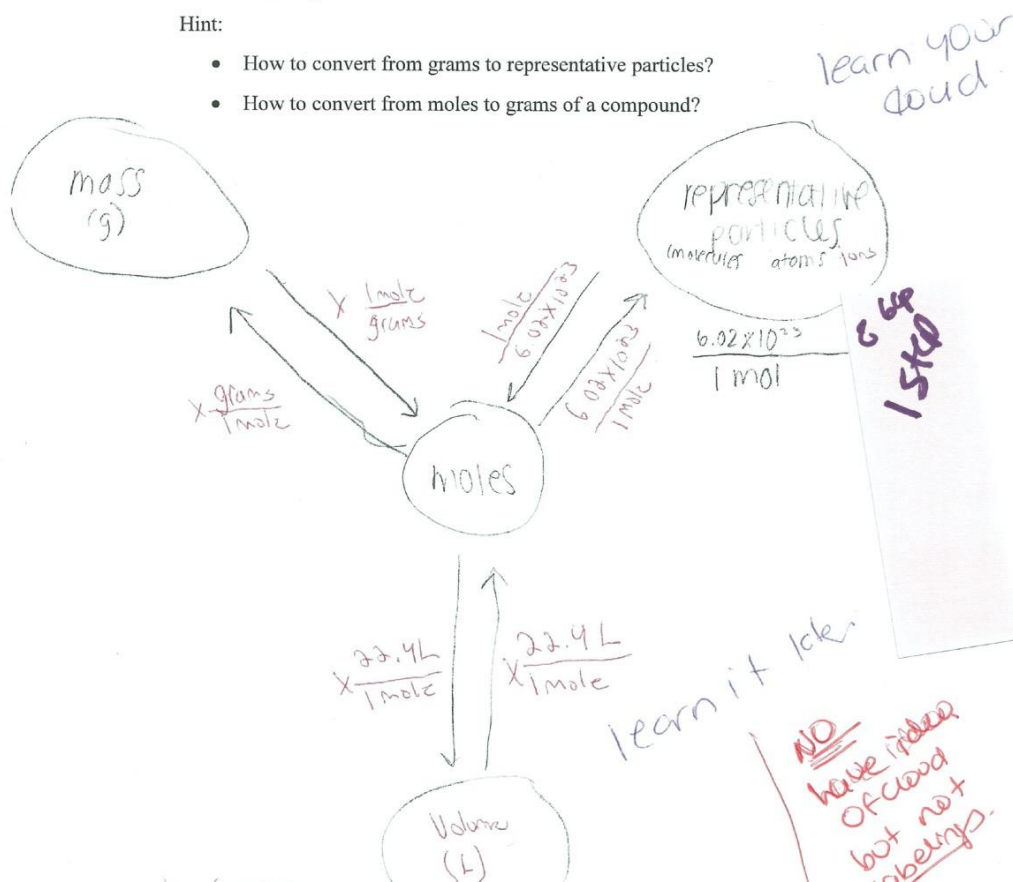


Figure 7. Documented Problem -Solution activity the Mole. An example of a student who could not draw, label and explain the cloud in detail.

The Mole Test

The results of the mole test from regular chemistry classes of 2019 and 2020 were compared to determine how the incorporation of blended learning and online resources helped chemistry students improve their understanding of difficult chemistry topics such as the mole and helped to improve their test scores. The 35 students who were taught using blended learning for the mole, had the test scores $M = 84.57$, compared to the 20 students taught using the traditional method of teaching the mole in the control group. This group had test scores $M = 74.40$, demonstrating better testing scores. The complete test scores can be found in Appendix F.

The two Mole Test scores from 2019 and 2020 were analyzed for each individual student using a score clustered column. Blue was used for the Mole Test of 2019 with 20 students' scores in total. Orange denotes the Mole Test of 2020 with 35 students' scores in total (Figure 8).

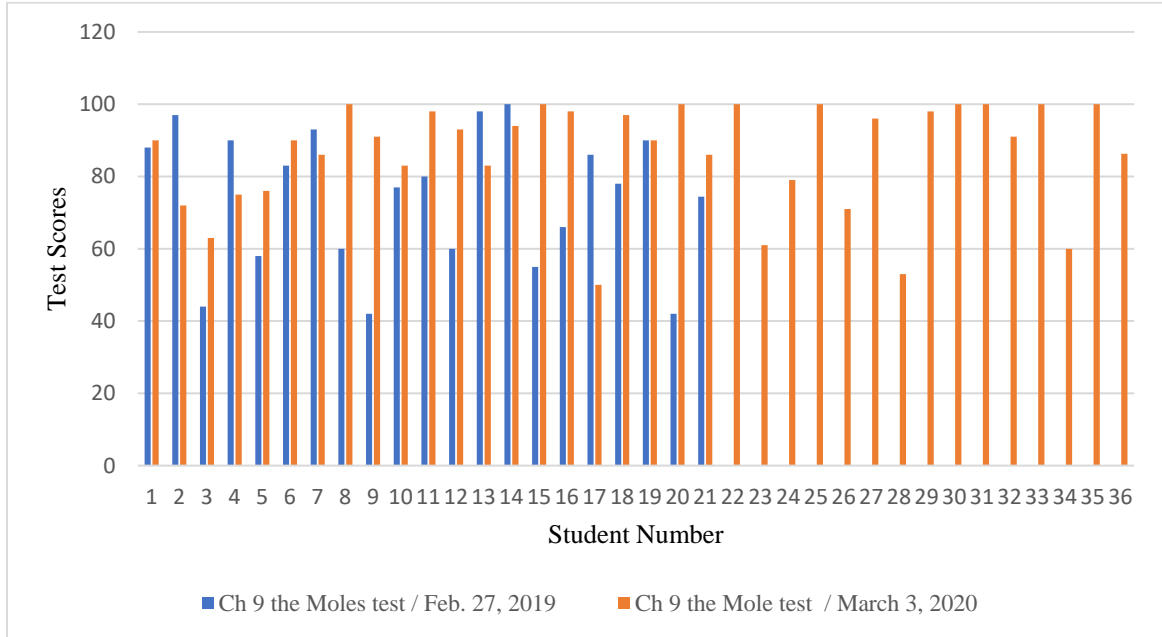


Figure 8. Score clustered column showing The Mole Test results blue 2019, ($N=20$) and orange 2020, ($N=35$).

This improvement in student achievement was verified by using the statistical t -Test data from the scores of both classes. The results of the statistical test for independent T -Test using a T -test calculator and using a significance value of .05, and using a one-tailed hypothesis, gave the following results: The t -value is -2.58119. The p -value is .006325. The result is significant at ($p < .05$). This indicates that the use of blended learning was a success in improving students' understanding and their score in the mole unit is due by the implement of blended learning rather than random chance. Complete t -Test analysis found on Appendix G.

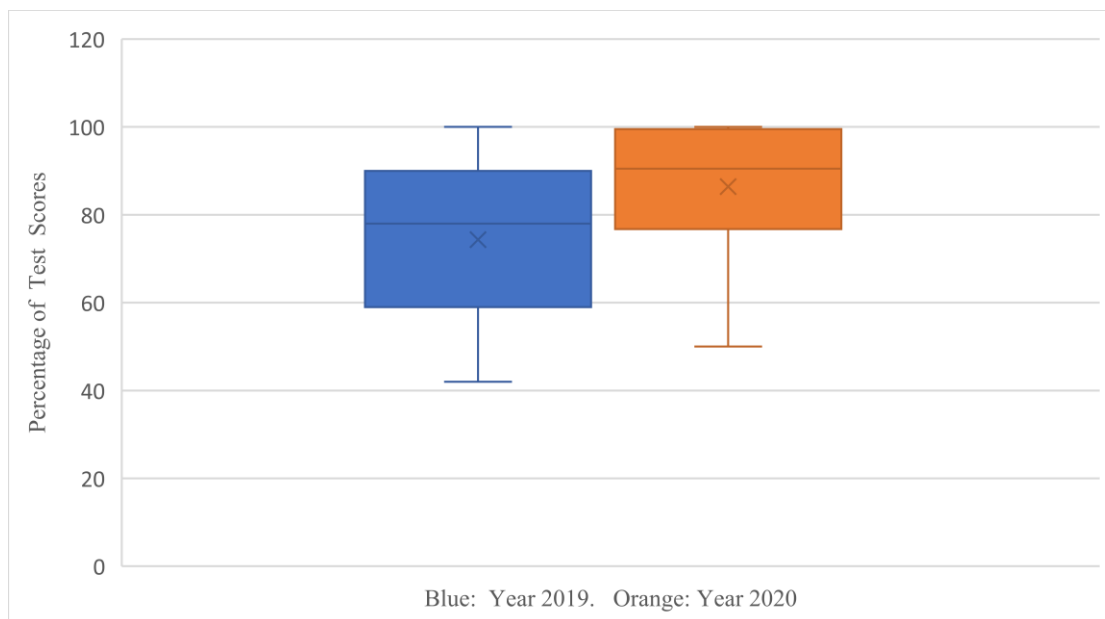


Figure 9. Score Whisker and Boxplots showing The Mole test results blue 2019, ($N=20$) and orange 2020, ($N=35$).

Pre-treatment Chemistry Survey 1 and Post-treatment Chemistry Survey 2

The results of the Pre-treatment Chemistry Survey 1 and Post-treatment Chemistry Survey 2 were analyzed to determine the influence of blended learning in students grade improvement and the understanding of chemistry while observing a reduction in anxiety levels. It was utilized a Likert scale where they could agree, tend to agree, tend to disagree or disagree with the statement given. These surveys were evaluated by comparing the two survey results, looking for trends related to change in the way students thought they learned chemistry better and to see the level of anxiety using different teaching methods.

As a result of the study, students' use of discussion with classmates to understand chemistry didn't change. In the pre-survey, students reporting tending to agree and to

agreeing with the statement remained relatively the same at approximately 79% (Figure 10).

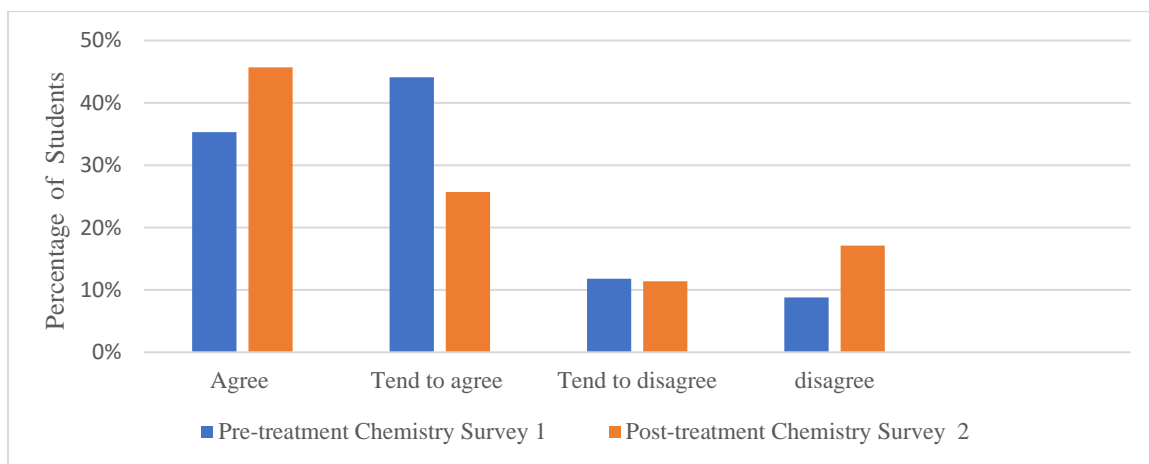


Figure 10. Pre-treatment Chemistry Survey 1 and Post-treatment Chemistry Survey 2: To understand Chemistry, I discussed it with friends or other students (Question 1).

From the Pre-treatment Chemistry Survey 1 and Post-treatment Chemistry Survey 2 where it did show significant improvements in students, was in the used of online resources and visual aids, such as the cloud to improve their understanding of difficult chemistry topics. Students reporting tending to agree and to agreeing with the statement went up from 65% to 98% (Figure 11).

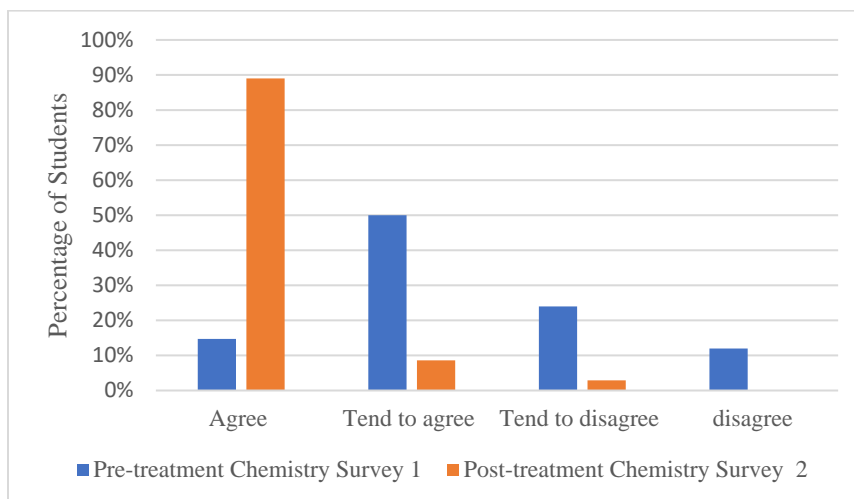


Figure 11. Pre-treatment Chemistry Survey 1 and Post-treatment Chemistry Survey 2: To analyze and solve a problem, I use a visual resource such as “the cloud” (Question 5).

From the Pre-treatment Chemistry Survey 1 and Post-treatment Chemistry Survey 2 question number ten asked students if teacher lecturing first made them feel less stressful. The results of the survey indicated that after the post treatment 82.9 % of the students felt less stress, in comparison to 91% of the results given prior to the treatment (Figure 12).

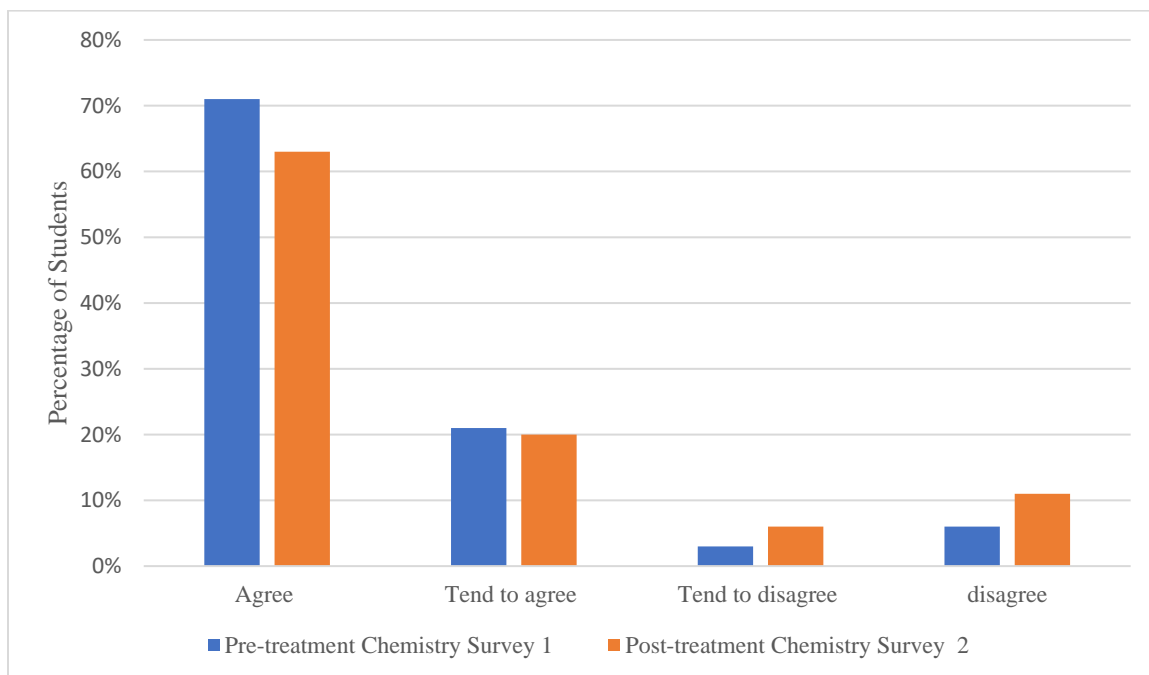


Figure 12. The above method of teacher lecturing first, makes me feel less stressful (Question 5).

CHAPTER 5

CLAIM, EVIDENCE AND REASONING

Claims from the Study

The Minute Paper was my first activity at the beginning of the action research. It was not evident from the Minute Paper that students were able to meet the objectives of the lesson, which were to define how a mole is used in chemistry, relate a mole to counting units and convert moles of representative particles and the number of representative particles to moles.

At the beginning of the activity, students were nervous because they did not want their grades to drop. They thought I was going to give them a pop quiz, and some said they had not studied to be prepared for this lesson. When it was explained that there would be no wrong or right answers, students' level of stress was reduced. I explained that this activity was for me to see how well they had comprehended the online assignment given in the previous lesson, and to identify gaps they could have so that I could close them. I also explained that it would help us all to do our best in the class. When they heard the last sentence, they were all at ease.

Since this was our initial activity after implementing blended learning, the students and I both struggled with the new methodology, because students had to take complete responsibility for their own learning. Some comments that students made were that they would rather that the teacher teach, instead of viewing videos and answering questions or figuring out the lesson on their own. I could see that they needed much

more help than I anticipated. My Bridge Students were struggling the most; my guess was that they were used to being helped and guided by teachers all the time.

From the time I chose to work with Documented Problem- Solution assessment, I knew that the results were going to give me great feedback. The results were better than I expected. I wanted to evaluate how the use of blended learning had helped my chemistry students so far, and it seemed that it was helping more than I had anticipated. Even though students would have access to the cloud in the test because I was going to provide it. I could see how students remembered a lot about the cloud. After reading each of their answers and trying to put them into three categories, I was so happy to see that students were prepared. Students were learning and applying what had been taught in class even when not asked to study the material ahead of time. This activity confirmed that blended learning and homework reinforced the knowledge learned in class and prepared students for the test.

This activity has reassured me to continue teaching using visual aids, so students can use those aids later in their homework or test, such as the cloud. It helped students in understanding and later applying the mole concepts. I am planning to do this same activity in the future, with no changes in the assessment. This will help me determine if any students in my other classes need extra help.

The use of blended learning helped students to improve their understanding of difficult chemistry topics such as the mole, and grades were improved. This was proved by the results of the Mole Test from regular chemistry classes of 2019 and 2020 when compared and showed that the test scores improved significantly.

Value of the Study and Consideration for Future Research

Some of the problems I encountered at the beginning had to do with technology and internal school restrictions. YouTube was restricted if students used a different email to log in than their school email. Chrome browser had to be used only. These instructions were given multiple times and students still did not follow them, building up frustration in both the students and me.

What I could take away from the Minute Paper was that it was our initial activity after blended learning had been first implemented. Students and I were both struggling with the new methodology of teaching mainly because it gave the students complete responsibility for their own learning. Some comments that students made were that they would rather the teacher to teach instead of viewing videos and answering questions and instead of figuring out the lesson on their own. I could see that they needed much more help than I had anticipated. My Bridge Students were struggling the most; my guess was that they were so used to being helped and guided by teachers all the time in all their classes and in the Bridge class. In the future, I will use this same activity but maybe after my third lesson.

Another problem encountered with assignments given was that students did not read the complete instructions. They just skimmed the instructions and their answers would be wrong because they were missing important information. Getting bad grades or seeing many wrong answers discouraged some students who simply decided not to do their best. I had to talk with each student and encourage them to continue learning despite the outcome. I found a quote from Kobe Bryant who my students admired so much and

who had recently passed away, that I shared with the class: “I have nothing in common with lazy people who blame others for their lack of success. Great things come from hard work and perseverance. No excuses.”

My goal was to help my Bridge Students with different learning disabilities or styles, but they were the ones struggling a lot during the whole process. Some problems I encountered were their failures to either do or complete their assignments at home which they fail to do so. This resulted in them not understanding the lesson. Several times they came to me saying how they would rather have direct teacher instruction. It was not until I reviewed the lesson, that they could understand it. Another problem I encountered was when students were asked to work in groups. My Bridge Students would get so easily distracted that they would not do their work unless I was reminding them to stay focused.

As I shared my findings and results with other colleagues and teachers, I came to the conclusion that our Bridge Students are so used to have direct instruction all the time and sometimes one on one instruction, that when given the task to work by themselves they cannot do so. They feel so lost. This led to frustration and they simply did not do the assignments. I had to talk with each Bridge Student to encourage them to keep doing their best. I kept reminding them that in life they will have to deal with different styles of instruction, and they would need to adapt and make the best of it.

I wanted to mention that my average and advanced students benefited the most and enjoyed more working with blended learning. I could see improvement in students’

understanding and grades from previous years overall. In fact, when I graded their chapter 12 the mole test and saw their grades, I realized this.

I wish I could have had more time to analyze more in detail and share more of my findings of my Pre-treatment Chemistry Survey 1 and Post-treatment Chemistry Survey 2 and but because of the Covid-19 and the movement to online instruction, my time and resources were limited. Now I need to focus on providing my students the best online instruction possible in the middle of all the uncertainty, fear, anxiety and changes that are happening in our city, state and country.

Closing the Loop

I shared the results of the Action Research with my students, stating that I was so proud of each one of them. I continue to encourage them to work hard, do their best, and seek help whenever it was needed. I reminded them that the ones who need help were not in class that day or had an off day, which we all have in times. I shared with them two videos: “Hard work never fails - motivational videos for students” (YouTube, 2018) and “Keep Going - Inspiring Christian Video” (YouTube, 2018). I continued over the following weeks to give them studying tips. I found a webpage that I used about studying skills: “Four Step Problem Solving, Problem Solving Worksheet, and Succeeding in the Sciences” (Rutgers, 2018).

Impact of Action Research on the Author

When I started my action research, I tried to keep a journal of what was happening in my classroom. The first day I started implementing the research, I called my

advisor, Dr. John Graves to let him know that both students and I were so stressed, frustrated, and felt really challenged with this new way of teaching. I did not think I would be able to implement blended learning for five weeks and survive. It would have been easier for me to just simply start teaching the traditional way and avoided many headaches during the day. Dr. Graves reminded me to keep my final goal in mind. My goal was that at the end, students would study and understand better a difficult unit such as the mole. Another goal was for students to succeed and enjoy learning in my chemistry class and, finally, for me to become a better teacher. Dr. Graves' kind words of encouragement kept me going with a positive attitude until the end.

By the middle of the research, students were getting the hang of it and were getting into a routine. Students seemed to be engaged and knew what they were doing.

By the end of the unit, when all tests were graded and scores compared with the previous year, and without doubt, the results indicated that my goal was fulfilled. It was also clear that I had helped my regular chemistry students improve their understanding of difficult chemistry topics. I was so delighted, pleased and with a thankful heart to God as I saw that all the tears, sweats, frustrations, long hours of planning, implementing and working with blended learning, had given a positive result. It was worth it all along. I hope and pray I can do this unit again next year in our traditional setting at school with students and teachers directly interacting with each other.

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APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD EXEMPTION



**INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 0000165**

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MEMORANDUM

TO: Perla Alvarenga de Garcia and John Graves
FROM: Mark Quinn *Mark Quinn CJ*
Chair, Institutional Review Board for the Protection of Human Subjects
DATE: December 5, 2019
RE: "The Effect of Blended Learning on High School Chemistry Class" [PAdG120519-EX]

The above research, described in your submission of December 4, 2019, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 16.111(a)(7).
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

THE MINUTE PAPER

**Westminster Academy
Science Department
Chemistry class
Dr. Perla Garcia**

Name: Date: Period:

The Minute Paper

Please answer the following questions:

a) What did you learn from this lesson? Explain

b) What are the things you are struggling with?

APPENDIX C

DOCUMENTED PROBLEM-SOLVING

Name:

Date:

As part of your journal activity: Document Problem Solution

You will draw and label “The Cloud” and explain in detail how to use the cloud to solve mole problems to someone who has not been in class. You will be given between five to ten minutes to answer the questions.

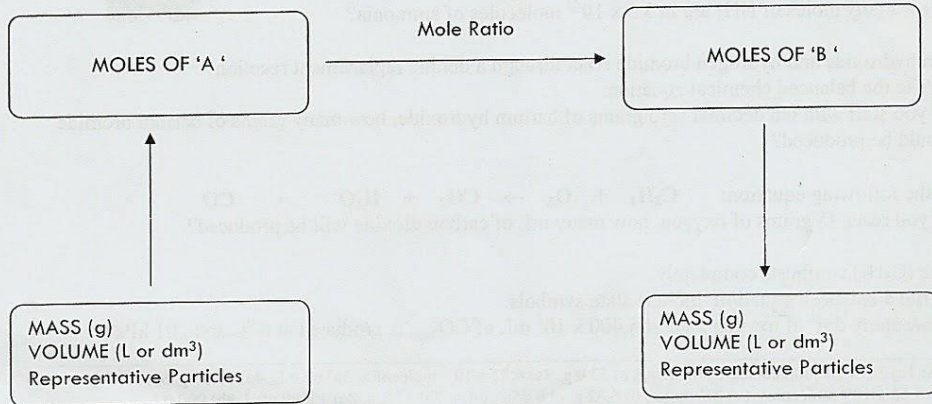
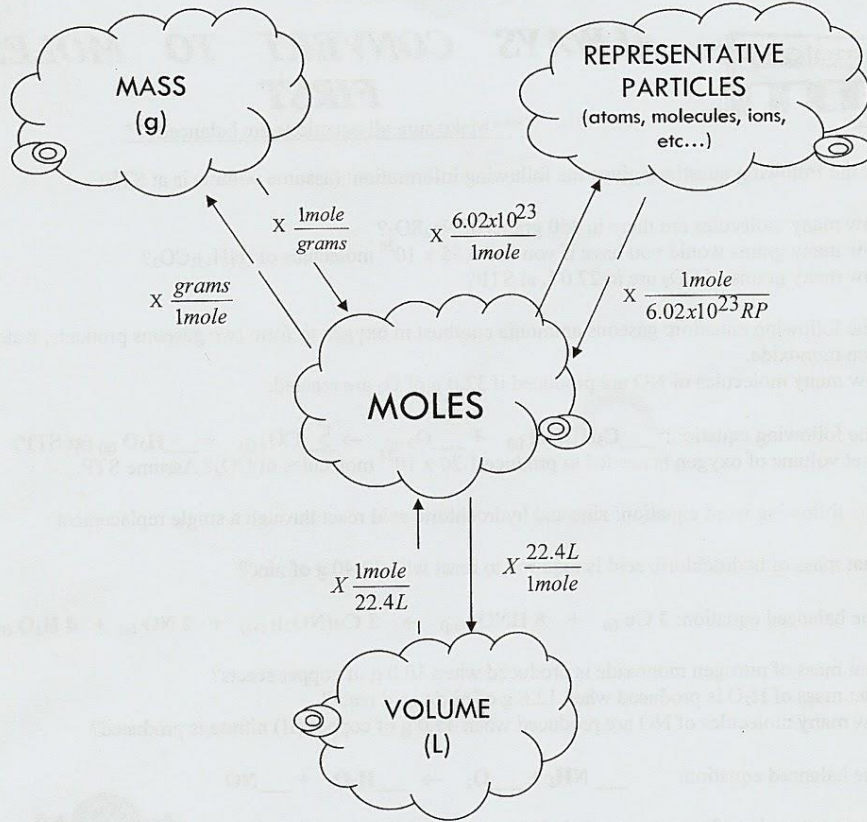
Hint:

- How to convert from grams to representative particles?
- How to convert from moles to grams of a compound?

APPENDIX D

THE CLOUD

MOLE CONVERSIONS



APPENDIX E

PRE-TREATMENT CHEMISTRY SURVEY AND POST-TREATMENT
CHEMISTRY SURVEY

Chemistry Survey 1

Participation in this survey is voluntary, and participation or non-participation will not affect your grades in any way. Here are a number of questions that may or may not describe the way you learn chemistry. The scale we will use is:

😊 1) Agree 2) Tend to agree 3) Tend to disagree 4) Disagree 😊

Choose one of the four answer choices that best describe what you believe is true for each question.

*** Required**

1. Email address *

2. 1) To understand Chemistry, I discussed it with friends or other students. *

Mark only one oval.

Agree

Tend to agree

Tend to disagree

Disagree

Other: _____

3. 2) To understand Chemistry, I just pay attention to the lecture and the class activities. *

Mark only one oval.

Agree

Tend to agree

Tend to disagree

Disagree

4. 3) To understand chemistry, I used Canvas online resources for reinforcement, like games, online videos, quizzes. *

Mark only one oval.

Agree

Tend to agree

Tend to disagree

Disagree

5. 4) I used Canvas resources prior to a lecture to help me understand chemistry better. *

Mark only one oval.

- Agree
 Tend to agree
 Tend to disagree
 Disagree

6. 5) To analyze and solve a problem, I use a visual resource such as "the cloud" *

Mark only one oval.

- Agree
 Tend to agree
 Tend to disagree
 Disagree

7. 6) Working at my own pace, using online resources in order to be prepared before the teacher lecture, made me feel less stress in class. *

Mark only one oval.

- Agree
 Tend to agree
 Tend to disagree
 Disagree

8. 7) The online videos and activities prior to a lecture, helped me understand chemistry better. *

Mark only one oval.

- Agree
 Tend to Agree
 Tend to disagree
 Disagree

10. 9) I rather to use class time so the teacher lecture first and then do my assignment. *

Mark only one oval.

- Agree
 Tend to agree
 Tend to disagree
 Disagree

11. 10) The above method of teacher lecturing first, makes me feel less stressful. *

Mark only one oval.

- Agree
 Tend to agree
 Tend to disagree
 Disagree

APPENDIX F

COMPLETE TEST SCORES 2019 AND 2020

	A	B	C	D
1		Ch 9 the moles test / 27-Feb		
2		88		
3		97		
4		44		
5		90		
6		58		
7		83		
8		93		
9		60		
10		42		
11		77		
12		80		
13		60		
14		98		
15		100		
16		55		
17		66		
18		86		
19		78		
20		90		
21		42		
22	AVERAGE	74.4		
23				

	A	B	C	D
	---		Ch 9 the Mole test / 03-Mar	
			90	
			72	
			63	
			75	
			76	
			90	
			86	
			100	
0			91	
1			83	
2			98	
3			93	
4			83	
5			94	
6			100	
7			98	
8			50	
9			97	
0			90	
1			100	
2			86	
3			100	
4			61	
5			79	
6			100	
7			71	
8			96	
9			53	
0			98	
1			100	
2			100	
3			91	
4			100	
5			60	
6			100	
7	Average		86.3	
8				

APPENDIX G

COMPLETE T-TEST ANALYSIS

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{(N_1 - 1)s_1^2 + (N_2 - 1)s_2^2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

Social Science Statistics

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{(N_1 - 1)s_1^2 + (N_2 - 1)s_2^2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

Home | Calculators | Descriptive Statistics | Merchandise | Tutorials | Quizzes | Which Statistics Test? | Contact

T-Test Calculator for 2 Independent Means

Note: You can find further information about this calculator, [here](#).

Success!

Explanation of results

The output of this calculator is pretty straightforward. The values of *t* and *p* appear at the bottom of the page. If the text is blue, your result is significant; if it's red, it's not. The only thing that might catch you out is the way that we've rounded the data. The data you see in front of you, apart from the *t* and *p* values at the page bottom, has been rounded to 2 significant figures. However, we did not round when actually calculating the values of *t* and *p*. This means if you try to calculate these values on the basis of the summary data provided here, you're likely going to end up with a different, less accurate, result. This is especially the case if you're dealing with numbers that are fractions of 1.

Treatment 1 (X)	Di ⁿ (X - M)	Sq. Di ⁿ (X - M) ²
88	13.65	186.32
97	22.65	513.02
44	-30.35	921.12
90	15.65	244.92
58	-16.35	267.32
83	8.65	74.82
93	18.65	347.82
60	-14.35	205.92
42	-32.35	1046.52
77	2.65	7.02
80	5.65	31.92
60	-14.35	205.92
98	23.65	559.32
100	25.65	657.92
55	-19.35	374.42
66	-8.35	69.72
86	11.65	135.72
78	3.65	13.32
90	15.65	244.92
42	-32.35	1046.52
N: 74.35		SS: 7154.55

Treatment 2 (X)	Di ⁿ (X - M)	Sq. Di ⁿ (X - M) ²
90	3.60	12.96
72	-14.40	207.36
63	-23.40	547.56
75	-11.40	129.96
76	-10.40	108.16
90	3.60	12.96
86	-0.40	0.16
100	13.60	184.96
91	4.60	21.16
83	-3.40	11.56
98	11.60	134.56
93	6.60	43.56
83	-3.40	11.56
94	7.60	57.76
100	13.60	184.96
98	11.60	134.56
50	-36.40	1324.96
97	10.60	112.36
90	3.60	12.96
100	13.60	184.96
86	-0.40	0.16
100	13.60	184.96

Significance Level:

.01
 .05
 .10

Difference Scores Calculations

Treatment 1



One-tailed or two-tailed hypothesis?:

- One-tailed
 Two-tailed

$$\begin{aligned}
 N_1 &: 20 \\
 df_1 &= N - 1 = 20 - 1 = 19 \\
 M_1 &: 74.35 \\
 SS_1 &: 7154.55 \\
 s^2_1 &= SS_1 / (N - 1) = 7154.55 / (20 - 1) = 376.56
 \end{aligned}$$

Treatment 2

$$\begin{aligned}
 N_2 &: 35 \\
 df_2 &= N - 1 = 35 - 1 = 34 \\
 M_2 &: 86.4 \\
 SS_2 &: 7546.4 \\
 s^2_2 &= SS_2 / (N - 1) = 7546.4 / (35 - 1) = 221.95
 \end{aligned}$$

T-value Calculation

$$\begin{aligned}
 s^2_p &= ((df_1 / (df_1 + df_2)) * s^2_1) + ((df_2 / (df_1 + df_2)) * s^2_2) \\
 &= ((19 / 53) * 376.56) + ((34 / 53) * 221.95) \\
 &= 277.38
 \end{aligned}$$

$$s^2_{M_1} = s^2_p / N_1 = 277.38 / 20 = 13.87$$

$$s^2_{M_2} = s^2_p / N_2 = 277.38 / 35 = 7.93$$

$$t = (M_1 - M_2) / \sqrt{(s^2_{M_1} + s^2_{M_2})} = -12.05 / \sqrt{21.79} = -2.58$$

The t-value is -2.58119. The p-value is .006325. The result is significant at $p < .05$.

Note: If you wish to calculate the effect size, this calculator will do the job.