

Learning Loss in Chemistry: Basis for Conceptualizing a Remedial Program

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Abstract

The abrupt lockdown due to COVID-19 pandemic challenges the education institutions. School closure challenges the education institutions to develop strategies to continue instruction. Classes was moved online preventing students and teachers from meeting face-to-face. This study was conducted to determine the learning loss in Chemistry and to conceptualize a remedial program based on the identified learning loss. One hundred Bachelor of Secondary students major in Science academic year 2022-2023 was the respondents of the study. Researcher-made survey instrument was administered to the students through google form. Result showed that the learning loss of students is on the problem-solving skill and the analyzation of problems. There is also a learning loss on the basic concepts in Chemistry which is the foundation as you move to the higher Chemistry subject. It is recommended to have remedial program on the problem-solving skills of student, a laboratory experiment is also necessary for the students to visualized the volumetric and gravimetric analysis and to solve titration problems. A review of the basic concepts of Chemistry is also part of the remedial program in order that the students will have a strong background of chemistry concepts.

Keywords: Chemistry, Learning loss, Online learning, Remedial program, COVID-19

INTRODUCTION

The COVID-19 pandemic has had a broad influence on society, people's quality of life, and the economic stability of many countries across the globe (Suwathanpornkul, et.al. 2023). The outbreak of COVID-19 in March 2020 has caused the most significant disruption to educational systems, affecting almost 1.6 billion learners in more than 190 nations across all continents and causing widespread panic. Closing of schools and other learning places has had an influence on 94% of the world's student population (UN 2020). Prolonged school closure has been adopted worldwide to control COVID-19 (Wu, et.al., 2021). School closure has created a drastic change in the education system. The sudden change in the education system challenges the educational institution to devise a model on how to deliver instruction outside of the school. Commission on Higher Education issued CHED Memorandum order no.4 s 2020 Guidelines in the Implementation of Flexible Learning. Higher Education Institutions adopts the Flexible Learning Model in the conduct of classes. Flexible Learning is a pedagogical strategy that allow flexibility in time and place (Cassidy, et.al. 2016). School closure in 2020 resulted in a significant disruption of education system that resulted to learning

losses and an increase in educational inequality (Maldonado & De Witte, 2020). Closing schools is considered as the most efficient intervention to prevent the spread of virus but many educators raised concerns about the effect of school closure on academic achievement of students (Hammerstein, et.al. 2021). Classes were moved online preventing teacher and student from meeting face-to-face. An online class is a course conducted over the internet. Online are generally self-paced, allowing for greater flexibility in completing coursework.

Online teaching and learning possess a challenge for both teacher and student especially in the adoption of new technology (Hamdan & Amorri, 2022). Since pandemic was unexpected and the shift from traditional to online learning was abrupt, many students faced a lot of challenges including the change of learning environment from classroom to home, student engagement and availability of gadgets and internet connection (Kunting & Naboia, 2022).

The transition in the education system negatively impacted the students' academic performance (Nazempour, et.al. 2022). Learning institutions was challenged to adopt online learning environment to deliver instruction. Online learning environment revealed a drop in a completed coursework and an increase in the dispersion of scores in the

test, students spend less time in studying during the pandemic (Engzell, et.al. 2021).

Formal education occurs in school, majority of this happened in the four corners of the classroom some are in the field. The closing of school and relocating the learners in a remote teaching results in a less time of students in learning (Di Pietro, et.al. 2020). Students experienced a serious disruption to their school and social lives (Mazrekaj & De Witte, 2023). Closure of school results in a learning loss (Kaffenberger 2021). Learning loss is the loss in academic knowledge and skills due to the extended time away from school or in-person instruction. There are several factors that affect the learning loss such as change in the teaching method, opportunities to reach education, less time for learning, less control and emotional factor (Zhdanov, et.al. 2022).

Learning loss happened when schools close for a long period of time due to pandemic or natural catastrophies. Learning loss was describes as the decline in students' skills and knowledge (Chusna & Andayani, 2022). The nature of the learning loss is extremely important. Because it will lead to finding a solution to the problem appropriately (Thumthong 2022). Learning loss due to COVID-19 in the science classroom extends beyond the academic

measurements of standardized assessments. This loss limits students' ability to apply what they learn in the classroom to the real world (Doyle, et.al. 2023). Learning loss arise as the effect of studying at home because of school closure. Learning loss during the pandemic was described by the researchers as the gap that is widening due to the lack of student involvement because they were studying at home because of school closure (Zhdanov, et.al. 2022). Learning loss is commonly addressed when schools close for extended periods of time during the summer, natural catastrophes, or epidemics. During pandemic, learning loss occurs as a result of studying at home due to school closure. Learning loss limits students' ability to apply what they learn in the classroom to the real world. While schools were closed during the pandemic, students did not have the opportunity to enhance what they learned in the sciences with hands-on and inquiry-based experiences (Doyle, et.al. 2023).

Chemistry is a branch of science that deals with the study of matter, its properties, composition, structure, changes, and the energy accompanying such changes and transformation. There are four main branches of chemistry – Inorganic chemistry, organic chemistry, analytical chemistry and biochemistry.

Inorganic Chemistry deals with the study of the behavior and properties of inorganic compounds including metals and organometallic compounds. Organic chemistry deals with the study of carbon-containing compounds. Analytical chemistry is the art obtaining and determining the quantity of matter. Biochemistry deals with the study of chemical substances related to living organism. In the Commission on Higher Education contents noted curriculum of Bachelor of Secondary Education major in Science, there were four major subjects in the Chemistry – Inorganic chemistry, organic chemistry, analytical chemistry, and biochemistry. Chemistry is a subject that requires computation, drawing structures, writing and balancing of chemical equations and laboratory experiments, however because of pandemic everything was moved online. Lectures, laboratory, exams, activities and quizzes was done virtually. Learning institutions used different online platforms in the delivery of instruction. Pandemic really brought a drastic change in the education system.

Thus, this study was conducted to determine the learning loss in Chemistry among Bachelor of Secondary Education major in science students at a public university in Pangasinan, Philippines during the COVID-19 pandemic. Specifically, it seeks to

determine the perception of students towards online classes, their learning experiences in their online classes during the COVID-19 pandemic, and to identify the learning loss of students during the COVID-19 pandemic.

METHOD

Research Design

Descriptive case study was used in this study. It aims to gather information or data that describes a situation, phenomenon or population. It tells a story about the people in a real-world situation. Survey and observation are the most commons tools used in descriptive research design (Voxco 2021).

Research Instrument

The research instrument is a researcher made survey instrument that measure the learning loss of the students. It includes the profile of the respondents such as their, sex, age, year level, gadget used for online learning and the internet connection at home used for online classes. Perception of students towards online learning is also a researcher-made survey instrument together with an open-ended question on experiences in learning in an online teaching and learning environment, the chemistry subject that the students had difficulty, the reason why they had difficulty with the subject, and the least mastered topics in Chemistry. It was validation by three experts in the field of Chemistry. The

three experts, a Professor, an Associate Professor, and an Assistant Professor.

Participants of the study

Participants were the Bachelor in Secondary Education major in science students at a public university in Pangasinan, Philippines, academic year 2022-2023. This university composed of nice campuses scattered along different towns in Pangasinan – Alaminos, Asingan, Binmaley, Bayambang, Infanta, Lingayen, San Carlos, Sta. Maria and Urdaneta. Among the nine campuses, there were five campus that offered BSE Science –Asingan, Binmaley, Bayambang, Lingayen and Urdaneta. Students from the five campuses participated in the study. Informed Consent Form was inserted in the questionnaire, students will read the informed consent form and proceed if they are willing to participate in the survey.

Data Analysis

Table 1: Profile of the Respondents

		Frequency	Percentage
Sex	Male	27	27
	Female	73	73
Age	18	1	1
	19	24	24
	20	25	25
	21	25	25
	22	18	18
	23	2	2
	27	1	1
	28	2	2
	36	1	1
	41	1	1
Total		100	100
Year level	First year	27	27

Data was analyzed using descriptive statistics and analysis of the responses of the students.

RESULT AND DISCUSSION

Profile of the Respondents

Profile of the respondents was shown in Table 1. One hundred students participated in the study, as shown in the table, female students dominated the study (73%). Majority of their age ranges from 19-22 years old. The youngest was 18 years old and the oldest was 41 years old. Interview with the students revealed that the 36-year-old and 41-year-old students were already married and had children. They stop their schooling when they got pregnant because no one will take care of their child. Most of the respondents are second year college students (30%), followed by first year students (27%), third year students (25%), and fourth year students (18%). The respondents were well distributed among the year levels.

	Second year	30	30
	Third year	25	25
	Fourth year	18	18
Total		100	100
Gadget use for online learning	Desktop	1	1
	Laptop	22	22
	Mobile phone	77	77
Total		100	100
Internet connection at home	PLDT fibr	12	12
	Converge	16	16
	Globe/Smart Broadband	6	6
	USATV	3	3
	Mobile data	63	63
Total		100	100

During the covid-19 pandemic, classes was moved online to avoid the spread of the virus. Students needs to attend their class in an online learning environment. In order to attend online class, student needs to have a gadget, survey shows that around 77% of the students used their mobile phone to attend their online classes, to take exams and quizzes, and to do their assignments

as shown in Table 1. Only 22% used a laptop and 1% used desktop computer. Internet connected is also needed in order to join the online class, as shown in the table majority of the students (63%) uses mobile data, they need to load and register in order to have access to the internet. Only few students had a wifi at home, some of them connects to the wifi of their neighbors.

Table 2: Perception of students towards online learning

	Average Weighted Mean	Standard Deviation	Descriptive Rating
I am motivated to learn in an online learning environment.	3.15	.8804	Neutral
I am interested to learn in an online learning environment.	3.23	.8022	Neutral
I always attend my classes online.	4.21	.8562	Strongly agree
I can easily answer exams and quizzes in an online learning environment.	3.79	.7823	Agree
I can easily do my assignments online.	3.77	.8391	Agree
I can easily understand the lesson online.	3.40	.8165	Neutral
I experience intermittent internet connectivity while having my online class.	3.94	.8387	Agree
I experience difficulty in learning in an online learning environment.	4.07	.7946	Agree
I experience anxiety in online learning.	3.96	.8030	Agree

	Average Weighted Mean	Standard Deviation	Descriptive Rating
I experience a limited interaction with my teachers and classmates in online learning.	4.08	.7872	Agree
I can easily cope up with missed lectures in an online learning environment.	2.63	1.050	Neutral
I can concentrate more on my studies in an online learning environment than face-to-face learning.	2.27	.7635	Disagree
Online learning is economic.	3.35	.7159	Neutral
Online learning is effective for presenting the lessons.	2.84	.8729	Neutral
Various media and learning platforms were used in online learning.	3.91	.7666	Agree
I prefer reading e-books than printed learning materials.	2.69	1.107	Neutral
I experience too many distractions in online classes	4.17	.8415	Agree
Hands-on laboratory activities are better than virtual.	4.31	.9067	Strongly agree
I experience uncondusive learning environment while having my online class.	3.68	.7089	Agree
I prefer online learning environment than face-to-face.	2.62	.9927	Disagree

Legend: 5.00-4.21 Strongly agree, 4.20-3.41 Agree, 3.40-2.61 Neutral, 2.60-1.81 Disagree, 1.80-1.00 Strongly Disagree

Perception of students towards online learning was revealed in Table 2. Hands-on laboratory activities are better than virtual received the highest average weighted mean which is 4.31, followed by 4.21, students always attend their online class using their mobile phone.

In an online environment, Students feel a decrease in interest in learning compared to face-to-face learning (Yuliyanto and Yamin, 2022). COVID-related learning loss in laboratory skills was seen in the topic Moles and Chemical Formulas, Gas Laws, and Concentrations of Solution. Students faced substantial challenges in these

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experiments, as they required stronger laboratory skills and math proficiency for calculations of laboratory reports. This experiment demanded a higher level of hands-on precision and specific laboratory skills, including precise measurements, the proper use of a Bunsen burner, and effective collaboration with laboratory partners (Yumak 2023).

Students also experience too may distraction in online classes with an average weighted mean of 4.17. The distractions are noisy environment, household chores and intermittent internet connection. Students do not have

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a conducive space in their home as they join the online class. Noisy environment includes the chicken crowed, crying babies or toddlers, noise of a vehicle, and voices of their housemates. Students was also task to do household chores at home even if they have an online class. Students also experience non-conducive learning environment at home with an average weighted mean of 3.68. Online learning is considered to be less effective by students in remote areas be because communication networks and infrastructure do not adequately support them to follow online learning (Harefa and Sihombing 2021). Students admits that they finds it hard to study online as compares to face-to-face because online classes is rarely interactive because students must remain muted during online classes in order for the teacher to be heard properly. Internet connection is also a problem especially when they turn on their camera as it required bigger bandwidth (Sultana, et.al. 2022)

In an open-ended survey given to the students, the following are some of the responses in terms of the environment at their home in the conduct of online classes.

Student 11: "The environment is not conducive for learning because it's so hot. Students have a hard time concentrating in a dark and humid area."

Student 44: "Because that time we are online and its difficulty to cope up because of the noisy environment"

Student 88: "Intermittent network is also a problem to learn and absorb those subjects easily."

Student 23: "We had a poor internet connection when we have a lecture online"

Students also experience limited interaction with teachers and their classmates with a mean of 4.08, the limited interaction with classmates caused anxiety for the students. They experience difficulty in learning in an online learning environment with a mean of 4.07. Students also experience intermittent internet connectivity while having my online class with a mean of 3.94. Remote education can have a deteriorating effect on students' learning outcomes through various mechanisms. During distance education, students had fewer opportunities to receive academic help from their teachers and peers (Vit 2023). Teachers also felt that they were less effective in teaching the curriculum through online learning, and observed that students from lower-income households were more likely to experience higher levels of learning losses (Zadorsky, 2023).

The following are the example student responses in an open-ended

survey on the challenges that they've encountered in their online class.

Student 1: "Teaching and learning virtually is not that very efficient, because of slow internet connection that is really the big problem why i had a difficulty with this subject."

Student 21: "The subject was conducted in online learning, we are unable to understand the subject due to poor internet connection."

Since a public university in Pangasinan, Philippines is in the Province, most of the students comes from a lower income family. There was a program from the Commission on Higher Education (CHED) wherein a free tuition fee for all the students of the State Colleges and University. The free tuition fee was subsidized by CHED. Students are enjoying the free tuition fee but when schools closed in March 2020, all subjects were moved online so they need to to buy load every day in order to connect to the internet. Internet connection is a big challenge for almost all of the students.

The lowest mean was 2.27 states that "I can concentrate more on my studies in an online learning environment than face-to-face learning", this means that students cannot concentrate in an online learning environment because of too many distractions. Students prefer face-to-face in all the Chemistry subjects.

Student 56: "I can't understand some of the concept. It is better when it is explained face to face."

Analysis of the responses of students, students prefer face-to-face classes that online, because in face-to-face, they can do hands-on activity like analyzing and solving chemistry problems. Online learning is a barrier to the engagement of students in real class activities. Student also lacks the influence of peer learning and these impacts on the student personality (Almahasees, Mohsen, and Amin, 2021)

All students experience poor internet connection in their home. The biggest challenge among teachers and students during the covid-19 lockdown was poor internet connection (Clarín & Baluyos, 2022). Students also reveal that chemistry must be taught face-to-face rather than online. Regular classes are better than online class in the learning efficacy and knowledge transfer (Selvaraj, et.al. 2021). Teachers also perceived that online learning is inefficient as the problem with communication, social development, and motivation problem emanates. Student learning loss was emphasized (Bezen and Demirkasimoglu 2022).

Experiences in learning Chemistry in an Online Learning Environment

Chemistry is an abstract subject, it requires analysis and problem solving. It is more of a hands-on activity. The

outbreak of COVID-19 lead to the school closure and the classes was moved online. Teachers and students was challenged to adapt to the new mode of teaching and learning which is virtual. The following are the example experiences of the students in an online learning environment:

Student 1: challenging

Student 2: I really hard time understanding the lesson during online session due to slow internet connection, noisy background and environment, and feel sleepy because there is no social interaction. In my own opinion, chemistry should be learned face-to-face because for me it is a complicated branch of science especially when you're not into it.

The results showed that students were challenge to the new teaching and learning strategy and the find it hard to cope up with the situation especially on technicality side wherein a lot of students had a poor internet connection. They find it hard to understand the concept because of the few interactions with the teacher. They also suffer a lot of distractions. They had a difficulty with problem solving. Others say that it is enjoyable but stressing.

Learning experiences of students in an online class revealed that students had difficulty in problem solving. They are confused with the problems.

Unconducive learning environment was also experienced by students, the reason why they cannot concentrate on their studies.

Chemistry subject that student had difficulty

Chemistry deals with the study of matter. There are five main branches of Chemistry which includes Inorganic Chemistry, Organic Chemistry, Analytical Chemistry and Biochemistry. In the University the major subject in chemistry includes Inorganic Chemistry, Organic Chemistry, Analytical Chemistry and Biochemistry.

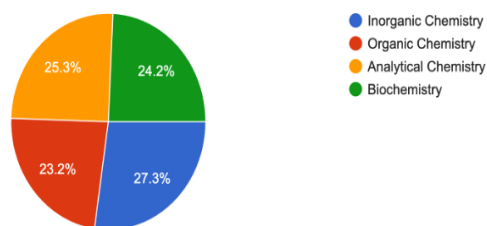


Figure 1 Percentage of students with difficulty in Chemistry subjects

Figure 1 showed the percentage of students with difficulty in Chemistry subject, it can be seen from the figure that the percentage of students with difficulty in Chemistry subjects is almost equal in all the chemistry subjects. Around twenty seven percent (27.3%) of the students had difficulty in Inorganic Chemistry. Inorganic Chemistry deals with the study of inorganic compounds, its properties and behavior which includes metals, organometallic compounds and minerals (ACS 2023). Students also had difficulty

in analytical chemistry (25.3%). Analytical chemistry deals with the quantification of matter, it determines the chemical composition of the compound (ThoughtCo. 2019). Inorganic chemistry is a pre-requisite of analytical chemistry. Both inorganic chemistry and analytical chemistry involves problem solving, students had a difficulty in analyzing and solving problems in chemistry. The high learning loss in chemistry concepts occurs more in the mastery of images that require numeracy skills in problem-solving (Anwar, et.al. 2023)

Although inorganic chemistry and analytical chemistry are the two highest in the rating of students in term of chemistry subjects that they had difficulty, the percentage of the inorganic chemistry and analytical chemistry is also comparable with the percentage of biochemistry and organic chemistry with a percentage of 24.2% and 23.2% respectively. Organic chemistry is a pre-requisite of biochemistry. Organic chemistry deals with the structure and reactions of compounds containing carbon while biochemistry deals with the application of chemistry in the study of biological processes. It is a chemical science and a life science as it investigates the chemistry of living organism (McGill 2023).

Reasons why students had difficulty in the different chemistry subjects

Students was asked to answer an open-ended survey to state their reason why they had difficulty in the major subjects in chemistry. Analysis of the responses of students revealed that they had a difficulty in solving chemistry problems. Students said that they had a non-stop problem solving, too many problems analysis, too many calculations, and too many formulas. The following are some of the example responses of students:

Student 8: "It's a complicated subject and has many computations."

Student 9: "There are so many concepts that you need to master so that you can understand and answer problems on your own."

Analysis of the responses of students also reveal that some students do not have a enough background of general chemistry, the reason why they had a hard time understanding chemistry concepts. Majority of the students are in the Humanities and Social Science (HUMSS) strand when they were in senior high school.

Student 15: "I had no background with this subject."

Student 52: "Since I am a HUMSS student, I don't have backgrounds on it therefore leading to difficulties in understanding some lessons."

Student 53: "I am a HUMSS student, therefore I have no background on it."

Least mastered topics in Chemistry

Least mastered topics are the topics that the students had difficulty. They cannot fully understand the topic. They are confused on what the topic is all about. Survey with the students revealed that they had a confusing in the topics in inorganic chemistry and analytical chemistry.

Student 1: I am confused with titration, redox reaction, gravimetric analysis

Students 3: Somewhere in Gravimetric Calculations, Volumetric Calculations, and Stoichiometry

Student 4: Thermodynamics, Volumetric Analysis, Stoichiometry, Buffers, Entropy

Student 16: Topics that involves solving problems and computations.

Student 22: Titration, Volumetric Analysis, Buffers, Back Titration

Student 35: gravimetric, Thermochemistry, Properties of Solution, Chemical Kinetics

Student 57: Electro chemistry, thermochemistry, chemical bonding, chemical equilibrium

Student 85: spectroscopy, electrochemistry, thermal analysis, separation, titration

Student 87: Mass spectrometry, Thermal analysis

Student 90: Standardization, Redox Reaction, Volumetric Analysis, Back titration, Acids and Bases

Some students' least mastered topics was in the area of organic chemistry and biochemistry.

Student 45: Resonance, Nomenclature of organic compounds, Alcohols, ethers, and epoxides, Aldehydes and ketones, Aromaticity and aromatic compounds

Student 29: The nomenclature and drawing the structure of lipids and nucleic acids.

Student 18: Acid and basis, Atomic structure, periodic table, redox, and polymers

Student 24: catabolism of carbohydrates, catabolism of lipids, catabolism of protein, Memorization of structures, Amino Acids

Student 50: Optical Activity, Chirality Centers, Alkyl Halides, Reactions of Alcohol, Nomenclature

Student 63: Enantiomers, Stereoisomer, Mechanism and Reactions, Functional Groups or Classes

The results revealed that there is a learning loss in Chemistry in terms of the problem-solving skills of students as there were no hands-on activities during the online class. They had a difficulty in analysing problems. There is also a

learning loss in the basic concepts of Chemistry that is why students cannot understand higher concepts of Chemistry. A mastery of the basic concepts of Chemistry which is general chemistry is needed because that is the foundation for higher Chemistry topics.

The least mastered concepts of students were in the topic inorganic chemistry and analytical chemistry. Student had difficulty in gravimetric analysis, volumetric analysis, titration, thermochemistry, and spectroscopy. During the pandemic, there is a learning loss in terms of the problem-solving skills of students. A learning loss in the basic concept of chemistry was also evident that is why students had a difficulty in solving analytical and stoichiometric problems because they lack the basic foundation of Chemistry. Remedial instruction is necessary to recover from the learning loss in chemistry.

COVID-19 Pandemic created a big challenge to the education system. Classes were moved online preventing teachers and students from meeting face-to-face to prevent the spread of virus. Throughout the COVID-19 pandemic, the immediate and longer-term effects of school closures and the interruptions on students' learning have been a source of consideration of University Institutions (Harmey & Moss, 2023). Educational

institutions were challenged to strategize on how to deliver instruction outside of the classroom and still meet the required competencies of the subject. In March 2020 every country in the world closed its schools when the full force of the pandemic hit. During this period all of the country used a variety of approaches to continue education (Jack & Oster, 2023). School closures were associated with reduced learning, increased anxiety and increased obesity in pupils (Hume S., et al. 2023). School closures due to COVID-19 created substantial disruptions in education, and this will impact the skills of students and their productivity when they mature as professionals (Cohen, et al. 2022).

The outbreak of the Covid-19 virus affected all aspects of life, particularly education. The Covid-19 pandemic transformed the educational system by shifting its learning mode to online learning (Turingan, et al. 2023). During the pandemic, educational institutions designed curriculum and prepared teaching-learning strategies to deliver instruction online (Tadesse, S. and Muluye, W. 2020). Various distance learning strategies were used during the school closure (Ariesta, et al. 2021). Most of the academic institutions adapted the flexible learning wherein synchronous and asynchronous classes will be adapted. Flexibility in teaching

and learning has become an emergency safety measure for school stakeholders during a crisis. It has been an essential component in the development of education to meet the diversified needs of students (Geverola, et.al. 2023). For the synchronous classes, Teacher and student will meet online or via the internet. For asynchronous classes, an activity or performance task will be given to the students.

Chemistry is a subject that students had difficulty. Chemistry has four main branches – Inorganic Chemistry, Organic Chemistry, Biochemistry, and Analytical Chemistry. Inorganic Chemistry is the study of properties, structures, reactions, and synthesis of compounds. It encompasses nonorganic compounds and overlaps with organic chemistry in the area of organometallic chemistry (Speight 2017). Organic Chemistry is the study of the properties, structure, composition, preparation and reactions of carbon-containing compounds. Most organic compounds contains carbon and hydrogen but it may also include other elements like oxygen, halogens, nitrogen, phosphorus, sulfur and silicon (ACS, American Chemical Society 2024). Biochemistry explores the chemical processes related to living organism (ACS, American Chemical Society 2024). Analytical Chemistry is the art

and science of determining what matter is and how much of it exists.

School closure due to COVID-19 pandemic caused a significant change in students learning outcome. Online teaching and learning challenged both teachers and the students. This study determined the learning loss in Chemistry among the Bachelor in Secondary Education students. One hundred students participated in the study and majority of their age ranges from 19-22 years old. The respondents was distributed among the different year levels. During the covid-19 pandemic students need to attend their synchronous classes online therefore a strong internet connection and a high-end gadget in needed in order for the students to attend the online class. However, result of this study shows that majority of the students do not have a laptop, they were using their mobile phone to attend their online classes and in doing their home-based assignments. Moreover, almost all of the students uses mobile data to attend their online classes. Everytime that they have a synchronous class they need to buy a load to join their online class. However, there were also students who cannot join the synchronous class because they do not have a money to buy for their load. Intermittent internet connection was also a problem experienced by students. Only few students had a wifi at home, some of

them connects to the wifi of their neighbors. The key challenges to online classes during the COVID-19 pandemic was the inadequate technical resources such as computers and quality mobile networks (Treve 2021).

Perception of the students towards online classes revealed that face-to-face classes and laboratory experiments is better than online. Students also faced distractions during online classes as their parents are requiring them to do household chores. Non-conducive for learning environment at home was also the problem of students during online classes as they experienced noise like chicken crowed, crying babies or toddlers, noise of a vehicle, and voices of their housemates while having online classes. Students also experience difficulty in solving problems in an online learning environment. They had a difficulty in all the areas of Chemistry especially in Inorganic Chemistry and Analytical Chemistry as these two areas of Chemistry requires problem solving.

Online teaching and learning offer limited opportunities compared to face-to-face education, the lessons are knowledge-based, and the students are only listeners and remain passive. Students do not find the opportunity to learn by living and experiencing (Demir, et. al. 2022).

Evidences strongly indicates that school closures result in learning loss. Learning loss could result to decrease future employment prospects and lower future earnings. This means that schooling matters. One promising policy option for mitigating learning losses during closures as well for subsequent learning recovery and acceleration is tutoring (Patrinos 2022). Learning loss was found out to have many “negative” impacts on school (Gunawan & Arrisman 2023). The learning loss in Chemistry during the COVID-19 pandemic was on the problem solving and laboratory skills of the students as these skills requires a hands-on activity. They had a difficulty in analyzing problems. The lack of opportunities to engage in learning activities at home led to the largest relative losses for students (Sabates, et.al. 2021). Learning loss is more significant in older learners, in those with lower prior achievement, and in areas of subjects that are more computational and procedural (Turner, 2020). School closure causes significant learning losses in cognitive skills and working memory (Kilenthong, et.al. 2023). Longer period of school closure was associated with larger learning loss. Learning loss was higher in low-achieving students and for schools with less socio-cultural capital. Although most teachers and students adapted to the pandemic situation in 2021

but still disadvantage students are at high risk to learning loss due to school closure (Schult, et.al., 2022). Learning loss was also observed in the basic concepts of Chemistry, the reason why students cannot understand higher concept. A mastery of the basic concepts of Chemistry is needed to be able to grasp the higher chemistry concepts. Students needs a strong foundation of General Chemistry before moving to a higher level of Chemistry.

CONCLUSION

The learning loss identified in the study was the problem-solving skills of students because they were hands-on activities to solve chemistry problems online. Students experienced intermittent internet connection in their online class, the reason why they cannot understand totally the lesson. They also lack laboratory activities to visualized titration in order on solve the problems on titration. Students lack the knowledge of analyzing the problem. A remedial instruction in Chemistry is needed to address the learning loss that the pandemic has brought to the students. Additional hands-on activities is necessary to train the students to solve a problem. Laboratory activities is also necessary for the students to visualize the chemical reactions and to solve the problems based on the result of the experiment.

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